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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN, THE NATIONAL IRONFOUNDING EMPLOYERS' FEDERATION, THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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The Invention of the Cupola.

Mr. D. H. Wood, in a Paper which he presented to the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen in 1929 on the History of Ironfounding in the Midlands, stated that John Wilkinson came to the Midlands in 1748. At Bilston he built the first blast furnace . . . he succeeded in substituting mineral coal for wood charcoal . . . *he was also undoubtedly the inventor of the cupola as it is known to-day.* (The italics are ours.)

Much additional light is thrown on the activities of Wilkinson—presumably John—which emends and amplifies Wood's historical researches by an article which has been prepared for "La Fonte" by Mr. Moutard, the Superintendent-General of the engineering side of the French Government Dockyards. It appears that the French Government in 1777 engaged Wilkinson at a salary of 12,000 livres a year to instal a dockyard at Indret. This enterprise was so successful that the Government in 1779 increased his salary to 50,000 livres a year. Apparently he resigned in 1780. This contradicts Wood's statement that Wilkinson was in the Midlands from 1748 to 1798. One of the most interesting statements in Mr. Moutard's thesis is that in 1780 Wilkinson invented reverberatory furnaces and his type of furnace is still known in France by the name of the inventor. "However," says Mr. Moutard, "several of the designs of Wilkinson, now no longer used, deserve to be resurrected."

We believe, however, the story of Wilkinson's connection with the cupola is of extreme interest. Although he had his reverberatory furnaces available, he installed two cupolas to melt the borings and turnings from the gun-machining shop, and in his inventory of 1780 prepared for his successor he calls his cupolas "*fourneau à limailles*"—literally "filings furnace." According to Moutard the first furnaces in which cast iron was melted in direct contact with solid fuel by means of an air blast had been working in France since the beginning of the eighteenth century. Many improvements, the most of which were due to Réaumur, had provided an iron shell, lined with refractory material, rotating on trunnions with a tap hole opposite the tuyere and at the same height. The essential improvement invented by Wilkinson was a fixed furnace having the tap hole at its floor level, which was an undoubted advantage, for it allowed one to work the furnace continuously and to eliminate interruptions in the casting process.

The particular furnaces in question were built up from two conical castings, 1.25 metres high and 0.875 metres in diameter at the centre of the height. At this position the internal diameter was 0.450 metres and the thickness of the lining about 21 centimetres. The height of the tuyere was not clearly defined nor was that of the slag hole. Moutard wholly confirms Wood when he says: "Thus one finds therein the fundamental characteristics of present-day cupola as Wilkinson's 'sleeve furnaces,' presented much the same dimensions and general aspect."

Cylinder Wear.—I.

The problem of cylinder wear, both in the automobile engine and in the heavy-oil engine, is one which has engaged the attention of foundry engineers for some years, and comparatively little progress has been made. One of the great difficulties is that of carrying out quick tests with respect to wear that have any relationship whatever to practical service conditions. The second is the difficulty of establishing any connection between wear and any of the commonly-used physical tests or composition. Recently, however, there has been a general tendency to believe that wear only occurs during a failure, in most cases purely temporary, of the lubrication. This is especially likely to occur during the starting-up period, and invariably takes place at the explosion end of the cylinder. We have also recently referred to the conclusions which point to the fact that conditions governing excessive wear lie outside the control of the metallurgist.

A report has recently appeared on cylinder wear prepared by the Institution of Automobile Engineers. They confirm that cylinder wear which is shown by piston slap, loss of power and increased oil consumption has been hitherto considered to be due to, or apt to be caused by, deficient lubrication or by dilution of the oil with petrol. They now say, however, that eighteen months' experiment has proved that the chief cause of abnormal cylinder wear is cold. They affirm that delayed warming up, particularly when accompanied by scanty lubrication, results in a marked increase in wear. One of the products of combustion is water, and at low temperature the water apparently condenses on the cylinder walls, with the result that it causes corrosion. This corrosion, it appears, does far more damage than the abrasive action of the ring on the cylinder wall, which has usually been regarded as the prime cause of wear. This conclusion is remarkably in line with other work, which emphasises the effect of corrosion as a contributory factor in causing mechanical damage. The obvious remedy for the maker is engines which warm up more quickly and corrosion-resisting liners. The user can retard wear by efficient lubrication and careful starting.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Pig-Iron with Higher Manganese Content.

To the Editor of The Foundry Trade Journal.

Sir,—I was very interested in the article by Mr. J. L. Francis concerning "Pig-iron with Higher Manganese Content" published in the issue of June 15, 1933. After having seen and experienced the beneficial effects of high manganese contents in pressure and chilled castings, one can fully endorse the value of using higher manganese contents in metal mixtures.

Conversing recently with a pig-iron supply house representative, he emphasised that "there was no demand for a high-manganese iron." This lack of demand may, perhaps, be attributed to the pig composition and type with which high manganese contents are usually associated.

Generally speaking, the high-manganese pig-irons are those of a hematite low-silicon type or those prepared for the basic open-hearth steel process, which contain 1.0-1.5 per cent. phosphorus. Also, since manganese lowers the liquidus of the Fe-C alloys, these irons are characterised by high total carbon contents and frequently are of hypereutectic (Kishy) nature.

Thus these irons, one with a low-silicon and the other containing over 1.0 per cent. phosphorus, both types having high total carbon contents, do not present an attractive metal upon which a foundryman can base his metal mixtures, particularly for high-grade castings. The difficulties of using such pig-irons can be very real and expensive, especially when there is a lack of proper metallurgical control and technique.

From the market there can be obtained irons with silicon at 2 to 3 per cent.; phosphorus 1.0 per cent. and manganese 1.5 per cent., and these are excellent "carriers" of high-scrap percentages for "ordinary" iron mixtures.

General observation indicates that East Coast hematites contain more manganese than do West Coast hematites, whilst irons from Lincolnshire and Northamptonshire frequently contain high percentages of manganese and phosphorus, owing to the ore beds in these counties being rich in these elements. Usually the range of manganese in "foundry" pig-iron varies from 0.5 to 1.2 per cent.

It seems reasonable that if the pig-iron suppliers provided an iron with medium silicon content, phosphorus a maximum at about 0.4 per cent., manganese at 1.6 to 1.8 per cent., with a total carbon content in the vicinity of 3.2 per cent., there would soon be a practical recognition of the beneficial effects of higher manganese contents in foundry-metal mixtures.—Yours, etc.,

H. W. Keeble.

Reddish, Stockport.
July 1, 1933.

To the Editor of The Foundry Trade Journal.

Sir,—I particularly appreciated the article "Pig-iron with Higher Manganese Content," by Mr. J. L. Francis, published in The Foundry Trade Journal of June 15, not only because it entirely corroborates my own experience and views which I have expressed on this question from time to time, but also because I feel that articles or Papers affecting such problems are of vital concern and valuable assets to the foundry trade. In these days of rapid scientific advancements, even in the foundry, the attention given to the lesser-used elements necessary for the production of particular types of high-quality castings are apt to cause one to think rather less of the more common elements such as manganese.

There is no doubt, as Mr. J. L. Francis says, that most grey-iron castings at present made would be better in every way if the manganese content were somewhat higher. Within the last twelve months I have had ample confirmation of the fact that increasing the manganese within reasonable limits does not affect the hardness or the amount of combined carbon present for a given section. It may, indirectly, even reduce the amount of combined carbon.

The problem that I had in mind was to use up considerable amounts of comparatively high-sulphur scrap and to produce from such metal light, machinable and hydraulically-tight castings, and the difficulty that immediately arose was that the high sulphur caused a chilling action in the very thin sections and resulted in these showing up white in places even when the silicon content was normal. By introducing a proportion of high-manganese (1.5 per cent.) pig, the trouble of the fracture running white was immediately corrected and, incidentally, the sulphur was found to be reduced somewhat.

The author has made reference to the presence of manganese in malleable cast iron. We are all familiar with Mr. E. R. Taylor's and Dr. Norbury's research work in this direction, where it was shown that the majority of white-heart malleable, as at present made, would benefit materially if the manganese was raised to a point where it balanced the sulphur. I may go further than this and say most definitely that in the production of black-heart malleable by the cupola, it is essential that the manganese shall be present to somewhat more than that required to balance the sulphur, otherwise the castings would not anneal satisfactorily.

There is just one point of criticism that I would like to make with regard to the above article, that is, mention is made that the average value for sulphur increase in re-melting in the cupola is 0.02 per cent. I am afraid I have never been able to secure as low a pick-up as this from an ordinary cupola, the pick-up being nearer 0.035 per cent., but with a properly controlled balanced-blast cupola it is possible for the sulphur pick-up to be only 50 or 60 per cent. of that obtained from a correctly-controlled ordinary type of cupola.—Yours, etc.,

H. H. Shepherd.

Crane, Limited, Ipswich.
July 3, 1933.

To the Editor of The Foundry Trade Journal.

Sir,—With reference to the article on "Pig-iron with a Higher Manganese Content" contributed to your columns by Mr. J. L. Francis. In his opening paragraph Mr. Francis indicates difficulty in obtaining suitable pig-iron containing a comparatively high proportion of manganese. This is not the case. A brief survey of the irons available from the leading blast-furnace plants in this country will reveal the fact that there are ample stocks of such iron awaiting the buyer.

Another important point is that some of the leading makers stock and sell their iron strictly to analysis, and a prospective buyer can always obtain a stock list giving the full analysis of each cast of iron in stock.—Yours, etc.,

H. W. Lockwood.

Stewarts and Lloyds, Limited,
Old Broad Street, London, E.C.2.
July 3, 1933.

Steel Consumption *per Capita.*—In an article on international co-operation in the steel industry by O. V. Halem, published in the "Deutsche Bergwerkszeitung," the author gives the fluctuations in steel consumption *per capita* in the four principal steel-producing countries during recent years. In each of the years 1928 to 1932, inclusive, the consumption in kilogrammes per head of total population was in Great Britain, 221, 243, 219, 174 and 156; France, 172, 209, 216, 165 and 122; Germany, 201, 200, 126, 69 and 57; and the United States, 475, 513, 372, 235 and 136.

Random Shots.

"Marksman" has been reading about safety-razor blade edges lately, so that he will know, when he is feverishly active before the shaving mirror in the morning, just why his blade refuses to cut smoothly. But hot weather does not encourage studious reading, and when "Marksman's" eye encountered the words "blade that was discarded during the eighth shave" his thoughts dallied with the delightful images that were conjured up . . . .

* * *

Mr. Syracuse, research metallurgist in the laboratories of a razor-blade manufacturing concern, was in the bathroom shaving laboriously. One side of his chin was very bristly, the other side was slightly less so—that was where he had shaved. At length he dismantled the razor, and instead of blistering the enamel on the bath with the heat of his language (as any ordinary mortal would do), trotted over to the sharpness numeral tester installed in one corner (tripping over his unslung braces in the process) and found that the sharpness numeral was only 100. He carefully put the blade aside and finished shaving with a new blade. Arriving at the works, he made an entry in the laboratory records: "Blade discarded during eighth shave."

* * *

A long line of hirsute men were passing into the shaving section of the research laboratories, where razor blades were undergoing tests while the men were undergoing shaves. A cry of anguish, muffled somewhat by lather, burst from one of the hirsute persons shaving before the long mirror.

"Lumme! guv'nor, this razor don't half scrape," he protested.

The razor was taken from him, the blade removed and labelled "discarded during eighth shave." The blade was then passed through to the research department proper.

* * *

"We are patronised by many discerning foundrymen, engineers, refractorers, quarry owners, etc., so, if you are not already a patron, join us the next time you are in town."

This is one of the paragraphs in a circular letter sent out recently from a restaurant in the West End. "Marksman" intends to dine there one evening, for it will be a joy to join the company assembled there. No one has ever spoken of "Marksman" as "discerning," but he knows now how to qualify for the distinction.

* * *

The policeman's son was learning music.

"How many beats are there to the bar in this piece of music, Dad?"

"Fancy asking a policeman a question like that," said the boy's mother. "If you asked your daddy how many bars there were to the beat he might have been able to tell you!"

* * *

"Hello, old man! How you have changed! What's making you look so old?"

"Trying to keep young," was the reply.

"Trying to keep young?"

"Yes — nine of them," was the gloomy response.

* * *

TUT! TUT!

Mr. C. E. Williams and Mr. J. J. McClelland, in their letter printed in last week's issue, thanked "one and all" of those who had helped financially to make the Cardiff Convention such a success. And above the letter was printed: "We accept no responsibility for the statements made or the opinions expressed by our correspondents."

Mr. Editor, how could you?

"Marksman."

Institute of British Foundrymen.

ANNUAL BANQUET AT CARDIFF.

The Annual Banquet of the Institute, which was followed by a dance, was held in the Whitehall Rooms, Park Hotel, Cardiff, on Wednesday evening, June 21, and the function afforded an opportunity to entertain a number of distinguished guests, many of whom had done much to make the meeting so enjoyable. The President (Mr. C. Edward Williams) was in the Chair, and was accompanied by Mrs. Williams. The company also included the Lord Mayor of Cardiff (Alderman C. F. Sanders, J.P.) and the Lady Mayoress (Miss Murial Sanders), Mr. D. Morgan Rees, J.P. (President, South Wales Institute of Engineers), Mr. W. E. Clement (President, Wales, Monmouthshire and West of England Branch of the Institute), Sir Ernest Bennett, M.P. (Under-Secretary to H.M. Postmaster-General), Mr. J. F. Rees, M.A., M.Com. (Principal, University College of South Wales and Monmouthshire), Prof. A. A. Read, T.D., D.Met. (Professor of Metallurgy at the College), Prof. J. H. Andrew (Sheffield), Mr. F. J. Cook (Past-President), Mr. Barrington Hooper, C.B.E., Mr. V. C. Faulkner (Past-President) and Mrs. Faulkner, Mr. F. W. Finch (the Institute's first Hon. Secretary), Mr. J. E. Hurst (Junior Vice-President), Mr. A. Harley (Past-President) and Mrs. Harley, Mr. Wesley Lambert, C.B.E. (Past-President), Mr. A. H. Moore (Benoni, South Africa), Dr. Carl W. Pfannenschmidt (of Germany), Mr. J. G. Pearce (director, British Cast Iron Research Association), Mr. V. Stobie (immediate Past-President), Mr. Roy Stubbs (Senior Vice-President), Dr. G. Vanzetti (of Italy) and Mr. D. H. Wood (Past-President of the Foundry Trades' Equipment and Supplies Association).

The Toasts.

The loyal toast having been honoured,

MR. V. STOBIE (Past-President) proposed "The City and Commerce of Cardiff." He commented upon many of the attractions of Cardiff, not the least of which were the magnificent buildings, including the City Hall, the National Museum and the Law Courts, and upon the *esprit de corps* which was so evident throughout the city. Its history could be traced back two thousand years —and yet in the whole of that time the Institute had met there only twice. (Laughter and applause.) As to commerce, he was delighted to know that the city was still holding its own in regard to the export of coal, and that its iron and steel and other industries were steadily improving.

Finally, he coupled with the toast the name of the Lord Mayor, and expressed thanks again for the delightful manner in which the members had been received at the City Hall on the previous evening.

The Growth of Cardiff.

The LORD MAYOR, in his response, gave an idea of the development of Cardiff by referring to five distinct phases in its history from the year 1801. In that year, he said, it had a population of 1,877; it was then a fishing village, and had no commerce worth mentioning. But a canal had been cut, down which coal was conveyed in horse-drawn lighters from the recently-opened mines. The coal export at that time was negligible. That phase of the history of Cardiff went on, with some development, for about 30 years, and at the end of that time the population was 6,000. Shortly after that, Lord Bute had commenced the building of the first docks, and from that time onwards dock followed dock and Cardiff developed at a very rapid rate; by the year 1870 the population numbered 45,000. From 1870 to 1890 was a period of tremendous progress, and people had poured in from the southern counties of Wales and England because they knew they would find employment in Cardiff. They were living in houses before the doors were put in and before the staircases were finished, and by 1890 the population of the extended Borough was 120,000. It was during that period that the business of the export of coal and of the various manufactories of the neighbourhood had increased so vastly. From 1890 to 1913 the growth was not so rapid, but during those years the population increased by 40,000 or 50,000, and in 1913—which was a year of great commercial prosperity throughout the kingdom—Cardiff had reached the very peak of its commercial development. From that time onwards it had not maintained the same rate of growth, but the population of the Borough had increased by about 40,000 from 1913 to 1933.

Commenting upon the industrial depression of the world, he expressed the hope that the cure

A CONFERENCE SNAPSHOT.
(Mr. C. E. Williams, President; Mrs. Williams; Mr. T. Makemson, General Secretary.)

would be found by the World Economic Conference which was being held in London. If only the various countries would discover—and he believed they were discovering it—that the exchange of their wealth for the wealth of other countries was the one thing needed to bring about prosperity, and if, having discovered that, they could at the same time find a way by which the wheels of commerce might again be set turning, then the world would again enjoy prosperity. We must throw down the walls of protection or prevention of exchange, or whatever it might be called. The intrinsic values of the world had not diminished, and the material things were at our hands ready for use. He did hope fervently that in one of the lands of this world there would be discovered, not a Mussolini, not a Hitler, or other type of dictator, but a great statesman who could show how the fortunes of the world could once more be re-established, or that the combined intelligence of those attending the World Economic Conference would discover a way.

MR. D. MORGAN REES, J.P. (President, South Wales Institute of Engineers), proposed "The Institute of British Foundrymen," and coupled with the toast the name of Mr. C. E. Williams, the President, and a very greatly-respected townsman of Cardiff.

Discussing the work of the Institute, Mr. Rees commented particularly on the fact that everybody in the foundry trade, from the apprentice to the employer, was eligible for membership and was within the membership. The Institute was concerned largely with the practical side of foundry work, but the theoretical and scientific side was by no means overlooked. He was satisfied that the Institute had realised that one could not carry on such a business by confining attention to the practical side only, and that it was impossible to ignore the scientific side and at the same time achieve success. He imagined that occasionally foundrymen experienced periods of anxiety, as, for instance, when they saw mild steel, high-tensile steel and other metals replacing cast iron here and there. At the same time, he suggested that the foundry trade could regard such changes with equanimity. It must be borne in mind, for instance, that all these metals had to pass through mills made of cast iron, and he imagined that the greater the output of mild steel for constructional work, the greater was the amount of castings necessary. Again, he had never heard of castings being imported from abroad, and it would appear that the foundry trade was protected by the very nature of that trade.

The South Wales Institute of Engineers had had a lengthy and valuable discussion on the causes of breakages in castings, in an endeavour to assist the manufacturers.

He understood that foundrymen used mostly fuels produced in this country, in the form of coke or pulverised coal, and that they were more economical than oil; he hoped they would continue to do so, and to keep British colliers employed. A great deal of attention had been given to this problem during the last few years, and already very satisfactory results had been achieved as the result of the agitation and the efforts to teach the users of oil that they were doing the wrong thing. The people of South Wales were very much concerned about the unemployment which was due to a large extent to coal being superseded by oil, but as citizens they were still more concerned as to what might happen if another war occurred. In that event we should be absolutely helpless—at any rate, that was the opinion of many people in South Wales.

In a tribute to Mr. Williams, he said that his many friends in Cardiff were very proud to know that he had been elected to the Presidency of the Institute.

The toast was received with musical honours.

What the Institute Does.

The PRESIDENT, after expressing his delight that the toast had been proposed by the President of a kindred body, said he was proud of the word "Institute," which he defined as "a society formed for literary and scientific purposes," and he was proud of the word "Foundrymen," so that he was proud of the combination "Institute of British Foundrymen." The work of the Institute was varied, and during the winter months the members had opportunities of discussing technical problems; but he would express thanks particularly to the Technical Committee and its sub-Committees for their activities. The members of the Committee had put in a great deal of work to help forward the knowledge of foundry practice, and he only wished that he could express worthily the praise due to them. They gave their time, they travelled long distances, at their own expense, to no selfish end, but in order to give their findings freely to foundrymen at large. There should have been a toast to the Technical Committee, and, indeed, he took the opportunity to invite the members to drink to the health of the Committee. (The toast was honoured with enthusiasm.)

Continuing, the President said he had been looking for bright signs, and he had found a bright fact, a bright sign and a bright motto. The bright fact was that the proposer of the

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toast, together with his sons, had had the pluck to establish a successful wire-rope works. The bright sign was that Mr. Stobie and Prof. J. H. Andrew (of the University of Sheffield) had undertaken an appeal for the establishment of a university course in Founding, leading up to the conferment of the degree of "B.Met. (Foundry)" upon all who qualified. The bright motto he had found in his daughter's bedroom; it was: "Keep smiling, though the skies are grey, and look upon the bright side; but if no bright side you can see, then polish up the dark side." The Institute of British Foundrymen might fairly say, he concluded, that it was doing all it could to polish up the dark side.

The Guests.

The final toast was that of "The Guests."

MR. W. E. CLEMENT (President, Wales, Monmouthshire and West of England Branch), who proposed it, said that the Institute was delighted to welcome on this occasion a large number of distinguished guests who were prominent in the educational and social life of the city of Cardiff. Among them he mentioned particularly Mr. J. F. Rees (Principal of the University College of South Wales and Monmouthshire), Mr. D. Morgan Rees (President of the South Wales Institute of Engineers), Sir Ernest Bennett (M.P. for one of the Cardiff divisions) and Prof. A. A. Read. In coupling with the toast the names of the two latter gentlemen, Mr. Clement said he had not the privilege of a long personal acquaintance with them, and did not know the extent of their sense of humour, so that perhaps he ought to propose the toast with the solemnity it deserved and take no risk. Sir Ernest Bennett, as Under-Secretary to H.M. Postmaster-General, was concerned in the running of one of the biggest businesses in the country. But he had no competitor! And he took the fullest advantage of his freedom to overcharge us to such an extent as to make a profit of millions a year. (Laughter.) It could not be denied, however, that the Department was run with efficiency. In a tribute to Prof. Read, who had started the Department of Metallurgy at University College, Mr. Clement also mentioned an equipment scheme which had been made possible by the generosity of the South Wales and Monmouthshire Coalowners' Association. Prof. Read had carried out a great deal of research work, especially on the carbides of special steels, and it had been carried out with such great thoroughness that it had become classical as an example of accuracy. Further, he had taken a keen interest in the local branch of the Institute of British Foundrymen, and had lectured to the members on more than one occasion.

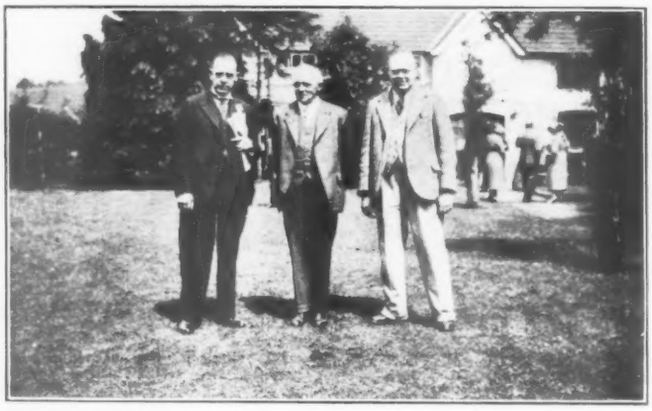
The Postal Barometer.

SIR ERNEST BENNETT said that he and his fellow guests were glad of this opportunity of honouring the President of the Institute and of honouring a great British industry. He was particularly pleased that Mr. Williams had been elected to the Presidency, for he belonged to a very well-known and respected firm, and not only was he esteemed by industrial leaders in South Wales, but he enjoyed the reputation of being a just and considerate employer.

Referring to the Post Office—which employed two-thirds of the entire Civil Service of this country—Sir Ernest said that since he had been brought into contact with it he had realised that it was a barometer of the prosperity or depression of our country. Figures brought to him on the previous day had proved that sales of stamps had increased greatly during the last month. He wondered if it were realised that the three-halfpenny stamp was an efficient, though unobtrusive, tax-gatherer—making three-farthings profit every time. (Laughter.) But apart from stamps, the telephone figures had increased, and there was also an increase in telegraphic business—which was the economic black sheep of the postal service. That increase was an indication that more business was being done, especially when there was an increase in the number of telegraphic messages sent abroad. He believed we could at last feel that the tide was turning; there were visible signs in various directions that Great Britain was getting back to the position she deserved to occupy.

PROF. A. A. READ, who also responded, said he felt he was doing so under false pretences, for a guest or visitor on this occasion might be defined as a stranger to Cardiff and a stranger to the Institute of British Foundrymen, whereas he was not guilty of either charge. He had spent many happy years in Cardiff, and had occasionally delivered lectures to the local Branch of the Institute—and it had appeared to him that the members of the Branch had been as happy to listen to him as he had been to lecture to them. The life and soul of the Branch was its Hon. Secretary, Mr. McClelland, and the members owed him a deep debt of gratitude for his splendid work. (Hear, hear.) Prof. Read also paid a tribute to the President of the Institute, who, in addition to being No. 1 on the books of the University College, was No. 1 in other directions. (Applause.)

A PARTY OF MEMBERS AND LADIES AT THE ROMAN AMPHITHEATRE, CAERLEON.



A TRIO OF INSTITUTE OFFICERS. (Mr. V. C. Faulkner, Past-President; Mr. C. E. Williams, President; Mr. R. W. Stubbs, Vice-President.)

CONCLUDING EVENTS.

The Technical Sessions were resumed on Thursday morning, June 22, at the South Wales Institute of Engineers. The meeting in the main hall was presided over by the President, Mr. C. E. Williams, while Mr. J. E. Hurst, Junior Vice-President, presided over Session B. While the meetings were in progress, the ladies were conducted over the Welsh National Museum, and at the conclusion the whole party of members and ladies travelled from Queen Street Station to Bristol, luncheon being served on the train.

On arrival at Stapleton Road Station, Bristol, the ladies visited the cocoa and chocolate factories of Messrs. J. S. Fry & Sons, Limited. The members were divided into two parties, one party visiting the tobacco works of Messrs. W. D. & H. O. Wills, and the other party visiting the works of the Bristol Aeroplane Company. Time was also found for a short drive past the Clifton Suspension Bridge and over the Clifton Downs, and the party returned to Cardiff in the evening.

Later in the evening a reception was held at the University College of South Wales and Monmouthshire, by kind invitation of the President, Council and Principal. The magnificent building, including the library and laboratories, was open for inspection. Of particular interest in the library was the first matriculation register of the College, opened at page one, showing the entry in 1883 of the name of the first student, Mr. C. E. Williams, now the President of the Institute. The PRESIDENT expressed the gratitude of all who were present to the President and Council of the University College, and specially to the Principal, Mr. F. J. Rees. PRINCIPAL REES briefly responded.

Whole-Day Excursion.

Friday, June 23, was given over to a whole-day excursion. The party left Cardiff by motor-coach, and a stop was made at Caerleon, where they were conducted over the Roman Amphitheatre. In Roman times Caerleon was the headquarters of the Second Legion and a city of considerable importance. Remains of very many Roman buildings have been excavated in recent years, and the remains of the Roman Amphitheatre are among the most perfect of their kind in the country. The journey was resumed by way of Usk and the Wye Valley to Tintern, where a halt was made for lunch.

After luncheon MR. C. E. WILLIAMS proposed a comprehensive vote of thanks to all who had contributed to the success of the Conference. He included in his resolution the Lord Mayor of Cardiff and the Lady Mayoress, the South Wales Institute of Engineers, the President and Principal of the University College, the subscribers to the Conference Fund, the directors and staffs of works which had been visited, and, particularly, the Conference Committee and its Secretary, Mr. J. J. McClelland, and his daughter, Mrs. Rawden. On behalf of all present at the Conference, he then presented a gold-mounted fountain-pen to Mr. McClelland, and Mrs. Williams made a presentation on behalf of the ladies to Mrs. Rawden. The resolution was seconded by MR. ROY STUBBS, Senior Vice-President, who, in the course of his remarks, showed his linguistic abilities by issuing in the Welsh language an invitation to Manchester for

1934. The vote of thanks was carried with loud applause.

MR. W. E. CLEMENT responded on behalf of the Wales and Monmouth Branch, and freely interpreted Mr. Stubbs' invitation in the Welsh language as "Come to the Ship Canal." MR. WM. WILLIAMS, ex-President of the Wales and Monmouth Branch, and Chairman of the Conference Committee, also responded, and paid a tribute to the work of Dr. W. R. D. Jones, who had compiled the souvenir booklet, and to the assistance rendered by the General Secretary of the Institute and his assistant.

MR. J. J. MCCLELLAND, the Honorary Secretary of the Conference, was received with loud and continued applause when he rose to reply to the vote of thanks. He acknowledged with gratitude the great help which he had received in organising the Conference from all concerned, and paid a special tribute to the assistance of his daughter, Mrs. Rawden, and to the never-failing support which he had received, not only in his work for the Wales and Monmouth Branch, but throughout his life, from his wife. He was specially delighted at receiving the fountain pen as a tangible token of their regard. Mrs. Rawden also responded.

After allowing time for inspection of Tintern Abbey, the journey was resumed along the Wye Valley to Sedbury Park, where tea was served. After tea, MR. VICTOR STOBIE, ex-President, and MR. JAMES SMITH, President of the National Iron Founding Employers' Federation, proposed and seconded, respectively, a vote of thanks to Mr. and Mrs. C. E. Williams for their untiring efforts in the organisation of the Conference. Mr. Williams briefly responded.

LIST OF MEMBERS ATTENDING THE CARDIFF CONFERENCE.

W. H. Allen, Birmingham; Prof. J. H. Andrew, Sheffield; G. L. Bailey, London; I. H. Baker, Wolverhampton; A. S. Beech, London; James Bell, Whitley Bay; H. H. Bennett, Pontypool; C. W. Bigg, Derby; H. J. Blight, Cardiff; L. W. Bolton, Birmingham; H. Bunting, Derby; C. J. Burgess, Port Talbot; E. A. Carlisle, Sheffield; G. C. Castle, Sheffield; W. E. Clement, Llanelly; F. L. Coles, Cardiff; F. J. Cook, Birmingham (Past-President); W. N. Cook, Manchester; J. E. Cooke, Manchester; J. H. Cooper, Darlington; W. R. Cooper, Walsall; H. Cowan, Falkirk; E. M. Currie, Coventry; D. Dalrymple, West Bromwich; V. Delport, London; J. Durrans, Penistone; P. H. Durrans, Penistone.

A. Edwards, Cheltenham; S. Evans, London; Dr. A. B. Everest, London; V. C. Faulkner, London (Past-President); J. Feasey, Lincoln; H. Field, Willenhall; F. W. Finch, Gloucester; C. Fontaine, Newport; G. E. France, Halifax; J. W. Gardom, Dunstable; E. Griffiths, Swansea; H. Griffiths, Cardiff; P. Gundry, Cornwall; A. Hares, Bristol; A. Harley, Coventry (Past-President); F. A. Harper, Middlesbrough; B. Hird, Newport; J. Hird, Dursley; J. Hogg, Burnley; W. Holland, Manchester; L. Holt, London; P. Hood-Williams, Sheffield; Barrington Hooper, London; C. A. Howe, Newport; R. E. Hoy, Hull; F. H. Hurren, Coventry; J. E. Hurst, Sheffield (Junior Vice-President).

S. L. Ireland, Birmingham; J. C. Jones, Workington; R. A. Jones, Manchester; Dr. W. R. D. Jones, Cardiff; C. H. Kain, Braintree; E. G. King, London; W. S. Kinsman, Cardiff; W. B. Lake, London (Hon. Treasurer); Wesley Lambert, London (Past-President); E. J. Lewis, West Bromwich; J. E. O. Little, Doncaster; R. A. Lloyd, Cardiff; Mr. — Lockney, Penarth; H. W. Lockwood, London; A. Logan, Newcastle; E. Longden, Manchester; A. R. Lucas, Workington; J. Lucas, Loughborough; G. T. Lunt, Wolverhampton; T. Makemson, Manchester (General Secretary); J. Masters, Shrewsbury; J. E. Mercer, Stockton; R. A. Miles, Manchester; E. Millington, Derby; W. J. Molineux, Wolverhampton; A. H. Moore, Benoni, South Africa; E. Morgan, Birmingham; W. G. Morgan, Coventry; Dr. P. M. Macnair, London; J. J. McClelland, Newport (Hon. Conference Secretary); F. E. McGrah, Wolverhampton.

F. K. Neath, Keighley; E. C. O'Brien, London; W. O'Keefe, Birmingham; J. G. Pearce, Birmingham; S. Pearson, Birmingham; Dr. Pfannenschmidt, Germany; A. Phillips, Manchester; H. Phillips, Wednesbury; C. D. Pollard, Sheffield; J. M. Primrose, Falkirk; J. S. G. Primrose, Manchester; S. Protheroe, Cardiff; N. D. Pullen, Warrington; H. Rea, Newport; C. E. Richards, Cardiff; T. D. Richards, Cardiff; R. J. Richardson, Pontypridd; N. D. Ridsdale, Middlesbrough; H. Roberts, Leeds; J. Robertson, Coatbridge; J. Roxburgh, Sheffield; F. S. Russell, Sheffield; P. A. Russell, Leicester; H. G. Schenk, London; H. Schofield, Manchester; R. J. Shaw, Derby; Dr. J. G. A. Skerl, Sheffield; J. Smith, South Shields; W. H. Smith, Birmingham; S. Southcott, Briton Ferry; R. Spriggs, Loughborough; Victor Stobie, Harrogate (Immediate Past-President); G. Senior, Sheffield; W. Stokes, Cardiff; Roy Stubbs, Manchester (Senior Vice-President); A. Sutcliffe, Bolton; Oliver Smalley, Pittsburgh, U.S.A.

J. B. R. Taverner, London; P. Talbot, London; A. W. W. Taylor, Briton Ferry; G. A. Taylor, Neath; A. Tipper, Birmingham; T. R. Twigger, Coventry; Dr. G. Vanzetti, Milan; A. S. Wall, Cardiff; F. J. Wares, Peterborough; W. Wilkinson, Ulverston; C. E. Williams, Cardiff (President); H. H. Williams, Cardiff; H. J. V. Williams, Cardiff; R. G. Williams, Cardiff; Wm. Williams, Cardiff; C. H. V. Wilson, London; R. Wilson, Wednesbury; N. F. S. Winter, Halifax; H. Winterton, Milngavie; D. H. Wood, Birmingham; A. S. Worcester, Huddersfield; Mr. — Wilks, West Bromwich.

German Foundrymen's Technical Association.

ANNUAL MEETING, 1933.

The annual meeting of the German Foundrymen's Technical Association, held in Berlin on June 10 and 11, was well attended by both German and foreign foundrymen and representatives of allied technical associations and institutions. The list of Papers read and the programme of the meeting were published in THE FOUNDRY TRADE JOURNAL of May 25. Summaries of the Papers "The Principles of Costing in Foundry Practice," by Herr J. Petin, and "The Mechanical Strength of Weldings and Castings," by Prof. Dr. A. Thum, are given below.

Costing in Foundry Practice.

The author pointed out in his Paper that the overhead charges to be included in foundry cost sheets depend on various factors, such as the activity of the foundry and the volume of orders in hand. Mere estimation of costs by a hard and fast scheme, unfortunately still a very common practice, can in most cases only result in a serious loss. A determination of the costs of production must be based on accurate calculations of every detail entering into the manufacturing process, with the addition of a due proportion of overhead and administration charges. The author did not consider the first item, as no successful foundry is incapable of a true calculation of the cost of the raw materials and of the wage charges in the production of each particular casting. The item of overhead charges, however, offers considerable difficulties, as it cannot be calculated for each individual piece of work, but must be carefully worked out on previous economic factors and a certain percentage added as an overhead supplement.

Rational and reliable costing requires the closest co-operation between the commercial and technical sides. The first calculation is the expenditure on the producing or manufacturing side, while an overall monthly balance sheet of every expenditure will indicate the proportional charges to be added to the materials and labour cost accounts. A continuous survey of the various items of expenditure can with advantage be plotted as curves, which will enable every detail to be profitably evaluated.

The utility of graphical costing was demonstrated by the author with graphs and costing sheets from a larger German foundry for the period 1929-1932. In this particular instance the curve showing receipts and that showing expenditure intersect at 34 per cent., indicating that below an activity of 34 per cent. of capacity expenditure is subject to a rapid rise. The curves clearly show that the economic results of a foundry are dependent on its degree of activity and that below a certain level a loss is inevitable. Each foundry should carry out such a fundamental survey to determine its specific critical limit of economic employment, which will show whether or not reorganisation in certain departments can result in an improvement.

Weldings and Castings.

In addition to economic production, the essence of a foundry process is the production of a safe structure of adequate mechanical strength. The cause of the majority of failures in use is the frequent fluctuation in the stresses imposed on a structure, so that a close study of fluctuating stresses and their effects is the principal desideratum in ensuring the safety of a finished piece of work. A mere knowledge of the normal strength is insufficient, as abnormal conditions of stress, such as a concentration of the lines of stress, are inseparable from the manifold variations in cross-section in even the simplest shaped form, and such abnormalities may considerably reduce the overall durability. The strength of unions and joints is also a factor of great importance. Repeated impact tests reveal the behaviour of a structure under continuous impact stresses and also bring out slight differences in otherwise homogeneous materials. In a bad weld, which may considerably reduce the normal strength of a piece, the geometrical shape of the weld is of more importance than the structure and thickness of the weld. Under fluctuating conditions of stress a casting possesses the same strength as a welded piece, while steel castings are stronger than weldings. Welding is simpler than casting as regards the complexity of the geometrical shapes to be handled. The aim of the foundryman should be the production of thin-walled reliable castings.

Catalogue Received.

Boiler Mountings and Valves. — It was a happy thought on the part of the compiler of a new 500-page catalogue, just issued by Messrs. Hopkinsons, Limited, Britannia Works, Huddersfield, to print in black type at the bottom of the introduction to this giant amongst trade literature an invitation to visit their works. It is very pleasing to us that, unlike many large engineering works, this firm is proud of its range of foundries, and opens up its catalogue by a description of this end of its business. The catalogue is divided into 17 sections, which occupy 535 well-illustrated pages, and yet, to have a complete picture of this firm's wide activities it must be supplemented by seven other publications!

Obviously, this book is meant primarily for the managers of boiler houses and those whose duty it is to supervise steam lines. We, therefore, suggest to our readers that, because of the compliments paid to the foundrymen in this book, they should pass on our recommendation of its great worth to their engineering colleagues.

Foundry Selling Practice.

WASTED OPPORTUNITIES—THE SALESMAN'S REPORT.

By Eric N. Simons.

The previous notes on wasted opportunities in selling foundry products dealt with those involving a direct contact with the customer, actual or potential. This article touches upon a slightly different source of opportunities, the reports from agents and salesmen. The representative's account of his doing is probably, in all foundries, one of the most important parts of the day's post, and it would be rash to suggest that foundries do not deal promptly and well with the correspondence they receive from their salesmen at home and abroad. But do they deal as promptly and well with these reports from the point of view of increasing the possibility of future sales? In many instances the answer is: they do not.

Let us examine what happens. The salesman's report contains orders, inquiries, instructions concerning letters he wishes the head office to write to firms upon whom he has called, and the like. He may ask questions or invite confirmation of answers he has given to the questions of customers. All these immediate matters are dealt with by the sales manager or his correspondence clerk. Then, in many instances, the reports are crossed through in pencil and filed. It is only extracted from the file when some further development of a particular matter calls for an examination of past transactions.

This is understandable, just as almost all instances of wasted opportunities are understandable. The correspondence clerk has to deal every day with a considerable mass of correspondence. The order and estimating departments are similarly placed. They simply have not the time to pore over each report and extract from it those inferences and details necessary from the point of view of sales promotion. If they tried to do so they would speedily be submerged by the next day's correspondence.

But there are, nevertheless, opportunities revealed in salesmen's reports that should not and must not be neglected. It will be well to consider these. In the first place, then, one may rule out of this article the matter of sales records based on representatives' reports, which matter has been fully dealt with in a previous article. But one cannot rule out the points now to be mentioned.

Utilisation of Established Data.

Facts about the castings are one of the first things the representative mentions in his letters, when he encounters them. For example, he calls upon John Smith & Company, and interviews the buyer, Mr. Jones. Mr. Jones tells him he is exceedingly pleased with the last lot of castings delivered. They had already outlasted others in the gravel pumps he makes, so considerably that he has been able to improve his guarantee of pump life to his customers, and to obtain more orders accordingly. He may even give figures. This information the salesman, if he has any sales sense in addition to his powers of salesmanship, passes on. Quite often the correspondence clerk thanks him for the information, expresses his pleasure in the facts revealed, marks the report "Acknd. 7.7.33," and files it. But here are facts of enormous value to the publicity and sales departments, facts that will tell when brought to the notice of customers. Clearly, then, the salesmen's reports should be combed for performance facts of this kind, quality facts, criticisms, commendations, and the like. Good performances or commendations should at once be circulated to all other representatives and agents. They are sales ammunition. They should be passed on to the publicity manager, that he may mention them in house organ, catalogue, circular or brochure.

Complaints or criticisms should be circulated among production staff, and not forgotten, but listed for a period and then examined. If over, say, three months, there is a general consensus of complaints of a particular character, *e.g.*, that castings are not true to shape, or have a bad finish, or have hard spots rendering machining difficult, obviously something more than mere frivolity is at the bottom of these grumbles and the trouble should be thoroughly investigated. Isolated complaints are sometimes investigated in foundries, but there is usually no systemised attempt to list and classify the troubles alluded to by the men in contact with the customers. Yet this systemisation is one of the finest stimuli, because it reveals to the foundry production staff the frequency with which particular complaints recur, and the excuse of "accident" or "misfortune" so often employed is at once eliminated, if the trouble is shown to be continuous.

Whom do They See?

The next point revealed by reports is the type of official to whom the representative gains access. The sales manager will have gathered from his experience whether the influential man amongst firms who buy his castings is the buyer in his office, the managing director in his board room, or the works engineer, or some other type of man. How many in his position will have systematically analysed for a period their salesmen's reports with a view to ascertaining whether, when they call upon firms, they see the right type of man? Assume, for example, that the real buying force is, for a particular type of castings, the works engineer or the foreman. Assume, also, that Brown, the salesman in Blankshire, sees, in the course of three months, 140 official buyers, five managing directors, ten works engineers and five foremen. Is it not obvious, at once, that he is failing to get hold of the right man in many of the works he calls upon? Allowance must, of course, be made for variation in methods of purchasing at particular firms; but, even so, there is revealed the fact that Brown does not often succeed in getting past the buyer, or is not trying hard enough to get past him. This calls for sales management, to put him in the proper way. But facts of this kind are not discovered unless they are tabulated for quick survey by the sales manager.

Then there is the wealth of information as to the officials met by the salesman, their positions, their names, their power to purchase, their standing with their employers. All this information is of value to the sales and publicity departments, because it enables them to build up efficient mailing lists for circulars and literature, and to alter and correct these from time to time. It enables circulars to be addressed to officials in person, instead of impersonally to their firms. One large foundry regularly, each day, gathers together all its salesmen's reports and forwards them to the publicity manager, who extracts data of this kind for them. No letter is allowed to go to file until his signature or initials are seen in the top left-hand corner of the reports. Any such report reaching the filing clerk without these initials is at once sent to him.

Those Telephone Calls!

One must next turn to somewhat more unpleasant aspects of the representatives' reports. These concern the indications they give whether or not their writers are doing their work conscientiously. Let me quote one example of the unsavoury possibilities that at times occur. It is fatally easy for a representative to do a good deal of his work by telephone from some hotel where he is made extremely comfortable, rather than by personal visit at the expense of time and energy. Such a man, if he falls into the temptation of reporting such conversations as "calls," may for a time create at headquarters an impression of activity and effort. For this reason, one sales manager in the foundry trade insists that all his salesmen shall indicate clearly on their reports whether or not the call was telephonic or actual. He recognises clearly that in certain instances a telephone call may be advisable and even advantageous; but all the same, he wishes to know about it. It may be argued that the salesman can still, if so disposed, cheat him by declaring falsely the proportion of telephonic to actual calls; but this is not so easy when the firm makes a practice of confirming most of its representatives' actual *visits*, and referring to "the visit paid to you by our Mr. Smith," and "the courteous reception you gave to him." The salesman knows there is always the possibility that some firm may deny his having called or visited, while if by chance no denial is made, there is always the chance of a meeting in the flesh between the buyer and the sales manager or some other works official. A record of calls, maintained regularly, indicates (1) the proportion of actual to telephonic calls made; (2) the average number of daily calls for each representative, which, when compared with turnovers and calls for other representatives, affords some illuminating comparisons and contrasts; (3) the proportion of interviews to failures to secure an interview.

This last is an important point, since it demonstrates the personal suitability of the representative and his ability or otherwise to overcome churlish or overworked buyers inclined to refuse admission to little known salesmen. If the calls analysis reveals a too large percentage of interviews refused, it is possible either that for some reason or other the salesman in question is not presentable or popular, or that he has not the necessary resource and initiative to enable him to overcome first and further rebuffs. In either event, the matter needs investigation by the sales manager.

It will be seen from what has been written that, quite apart from the day-to-day, immediate action it demands, the salesman's report offers opportunities for facilitating, promoting and controlling sales. All salesman's reports, unless the sales manager is satisfied with mere bald lists of calls, are market analysis in little, and should be so regarded.

Blasting Pits for Breaking Scrap Iron.—According to an article by R. Feuchtinger in "The Explosives Engineer," a large blasting pit for breaking scrap iron to furnace size is being used at a steel plant at Essen. Ingots, cast-iron pieces and iron waste from foundries are broken into convenient sizes by explosives. The blasting pit is 25 ft. long, 18 ft. wide and 13 ft. long. Its walls are lined with steel plates 1 ft. thick. Three large steel slabs, 1 ft. thick, and weighing a total of 83 tons, cover the pit. The cover plates are equipped with valves for releasing the explosives gases. In order to place the explosives charges in the large blocks of iron and steel, holes are burned into them by oxygen torches. The large pieces are then brought into the blasting pit by means of an electro-magnetic hoist and the dynamite loaded into the holes. After covering the pit with the heavy steel plates the charges are fired by an electric blasting machine. The process avoids the precautions and great space necessary in blasting large cast-iron pieces in the open, and has been found to be considerably more economical than hammering and other methods.

American Progress in the Use of Alloys in Cast Iron.*

[American Exchange Paper.]

By F. B. Coyle.[1]

The scope of American progress in the use of alloys in cast iron has been considered in its broadest sense throughout the following discussion. The development of the alloy cast-iron industry in both the United States and Canada has been so closely inter-related and industrial relations so intimate, that it was decided to broaden the scope of this Paper to include a description of accomplishment in both countries as "American Progress." The term "cast iron" has also been adopted in a broad sense and considered to include not only grey cast iron but chilled and white iron as well. In America the alloying elements commonly used either singly or in various combinations are nickel, chromium and molybdenum. Vanadium and titanium are also used but to a limited extent.

During the period 1916 to 1921, the use of small percentages (5 per cent. to 15 per cent.) of Mayari pig-iron in cupola mixtures was found to improve the general qualities of castings produced therefrom. An extensive investigation of the properties of Mayari pig-iron was then made by Dr. R. Moldenke for the Bethlehem Steel Company and published in 1923.[2]

A further investigation of the application of nickel and chromium in iron castings was then conducted by P. D. Merica, T. H. Wickenden and J. S. Vanick and published in 1925.[3] During 1925 the value of nickel and chromium in iron castings was seriously introduced to the grey-iron industry. In 1930 the use of molybdenum and vanadium were advocated and since then the place of these elements has been definitely established in the iron-castings field. At the present time it can be confidently stated that the use of alloying elements in the iron-castings industry in America is firmly established.

In Fig. 1 is shown the total number of iron foundries in the United States and Canada since 1925, which was the earliest period in which authentic figures became available. Due to mergers and elimination, the total number of iron foundries decreased steadily from 4,515 in 1925 to 3,836 in 1932. During this same period the number of foundries producing alloy cast iron increased from 110 in 1925 to 972 in 1930 and decreased somewhat to 846 in 1932. While there were 3,836 foundries listed in 1932, many were not operating. There is no doubt that if this number were known then the percentage of foundries producing alloy iron would be greater than that shown.

The tonnage of cast iron and alloy cast iron produced since 1925 is shown in Fig. 2. The production of cast iron reached a peak of 18,976,000 tons in 1929, but has dropped consistently since then to only 3,930,000 tons in 1932. The peak of production of alloyed iron was 198,000 tons. While the production of alloy cast iron has dropped consistently since 1929 to 77,080 tons in 1932, the rate of decrease has been less than that of cast iron. This is clearly indicated by the graph showing the percentage of alloy cast iron of total production. The percentage of alloy iron rose rapidly from 1926 to 1928, remained about the same until 1931 and then showed its greatest percentage increase in 1932. Last year 1.975 per cent. of all iron castings produced contained alloying elements. Cast-iron production decreased 55 per cent. in 1932 as compared with 1931, but alloy-cast-iron

MR. F. B. COYLE.

production decreased only 23.5 per cent. in 1932 as compared with 1931. The estimated tonnage of total grey-iron production is based upon a general survey of the industry conducted by "The Iron Age" in 1926. This is the only accurate record which has been compiled in America. It was found that 21.9 per cent. of all pig-iron produced in 1926 was consumed in grey-iron production. It has been estimated that the average pig-iron content of furnace charges in all branches of castings production is 50 per cent. The author has assumed that the proportion of pig-iron entering into grey-iron castings during the years 1927 to 1932 has remained constant. The graph for alloy cast iron has been estimated from the sales records of the International Nickel Company, the Climax Molybdenum Company and the Molybdenum Corporation of America. Since no data with reference to consumption of Mayari pig-iron or secondary metals were available, the figures for alloy-iron production are no doubt below actual production. It has been considered by a number of individuals, however, that Fig. 2 presents a fairly reliable picture of proportions of alloy-iron to grey-iron production in America.

These charts show a substantial progress in the production of alloy cast iron particularly during a period of severe industrial depression. The advantages derived from the use of alloying elements in cast iron can be classed in two categories:—(*a*) To improve the properties of general castings and to aid in the solution of practical casting problems, and (*b*) in castings for special fields of application.

Use of Alloying Elements in General Casting Production.

Until 1930, the major portion of alloy consumption in iron castings was devoted to the solution of or the alleviation of practical difficulties in general castings production or improving other desirable properties. In this class of castings the content of any alloying element is seldom as high as 3.5 per cent. Since 1930 the consumption of alloying elements in iron castings has increased materially, but in addition the use of these elements in higher alloy types of castings for special fields of application has been considerably extended. The special irons will be described later.

In America the alloying elements commonly used either singly or in various combinations in iron castings are nickel, chromium and molybdenum. Vanadium and titanium are also used, but to a limited extent. The practical difficulties in the solution of which alloying elements have proven of distinct value, as well as other properties improved by their use, are:—(1) Refinement of grain; (2) elimination of internal shrinkage and porosity; (3) elimination of chill and hard spots; (4) improved machinability; (5) increased resistance to wear; and (6) improved strength within certain limits.

Grain Refinement.

Grain refinement is desirable when castings must finish with a fine-machined or highly-polished surface. Iron castings which are to be subjected to galvanising, tinning or electroplating processes must have as fine grain as possible. Alloying elements are of distinct value in accomplishing this objective, because of their ability to increase the number of crystallisation nuclei, thereby decreasing the size of individual graphite particles as well as promoting uniform distribution of these particles.

In America, refinement of grain is usually accomplished by:—(*a*) Adding nickel, chromium and molybdenum alone or combinations of nickel with either of the other two elements to castings of relatively thin sections without change of base composition. When combinations of nickel and other alloying elements are used, the nickel content is usually two to three times the chromium content, or equal to the molybdenum content, in order to preserve grey characteristics and facilitating machining; and (*b*) lowering total-carbon or silicon or both and adding nickel to castings of relatively heavy sections. The nickel is added to prevent chill formation. Representative engineering applications of the use of nickel and chromium for refining grain of castings are shown in Table I.

Reduction of Internal Shrinkage or Porosity.

Whilst it is conceded that a well-designed casting would have all sections as nearly the same thickness as possible, the foundryman is often confronted with the problem of producing sound dense castings having sections varying widely in thickness. It is imperative that castings subjected to hydraulic or gaseous pressure be sound and dense. It is well known that, when silicon and phosphorus are sufficiently low, internal shrinkage is effectively eliminated. However, it is often necessary to reduce silicon to such an extent that chilled corners or edges are encountered. The joint action of reduction in silicon with addition of nickel prevents formation of internal shrinkage as well as chill, and at the same time facilitates machining operations. The desirable adjustment of silicon and nickel according to difference in thickness between the largest and smallest sections of a casting is shown in Fig 3. Typical industrial applications of this principle are given in Table II. If chromium or molybdenum are added with nickel to aid in developing such

* A Paper presented at the Cardiff Conference of the Institute of British Foundrymen.

1 Research Metallurgist, The International Nickel Co., Inc., 67, Wall Street, N.Y.C., U.S.A.

2 "The Effect of Nickel and Chromium in Iron Castings." R. Moldenke. A.I.M.E., 1923, page 930.

3 "Nickel and Nickel-Chromium in Cast Iron." T. H. Wickenden and J. S. Vanick, Trans. A.F.A., 1925, vol. 33, page 347.

additional properties as strength or hardness, the nickel content should be two to three times the chromium or equal to the molybdenum content used in order to maintain normal grey characteristics.

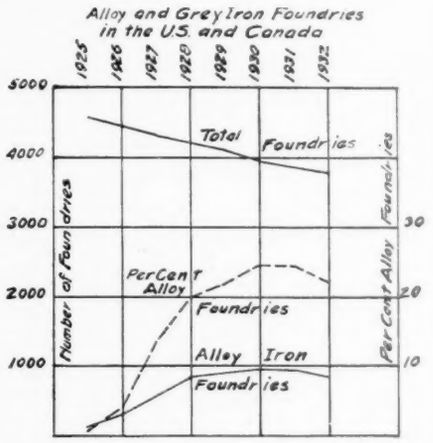


FIG. 1.—CAST-IRON AND ALLOY CAST-IRON-PRODUCING FOUNDRIES IN THE UNITED STATES AND CANADA SINCE 1925.

Elimination of Chill and Hard Spots.

Since nickel, like silicon, assists graphite formation and carbide decomposition, it is the chief alloying element used to eliminate chill. The reduction of chilling tendency of an iron and consequent elimination of hard and brittle spots from castings can be accomplished by increasing silicon. This, however, entails impairment of physical properties, more open grain, greater tendency to porosity and internal shrinkage, as well as decreased hardness and strength. The excellent properties obtainable in low-silicon iron can be retained and chill eliminated by the use of nickel. On the other hand, the properties of a low-silicon iron can be obtained in a high-silicon iron by adding nickel and chromium (providing the nickel content is at least two and one-half times the chromium content), or nickel and molybdenum (providing the nickel content is equal to the molybdenum content), while at the same time retaining the grey characteristics of the high-silicon iron. The minimum proportions of nickel and silicon required to produce grey fractures in sections of various thickness containing three ranges of total carbon content are shown in Figs. 4, *a*, *b* and *c*. Reference to Fig. 4, *b*, shows that a section ½ in. thick in a

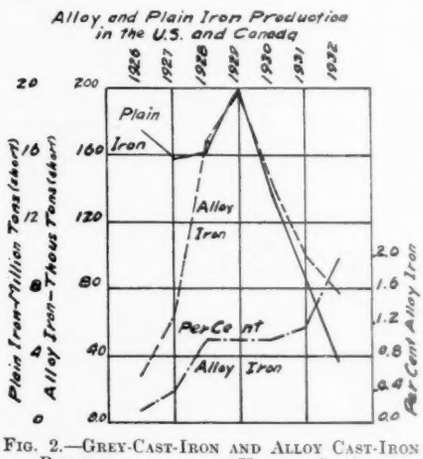


FIG. 2.—GREY-CAST-IRON AND ALLOY CAST-IRON PRODUCTION IN THE UNITED STATES AND CANADA SINCE 1926.

casting containing 3.25 to 3.40 per cent. total carbon and 1.0 per cent. silicon would have a white or mottled fracture. The addition of 1.0 per cent. nickel will render this same section completely grey.

Improved Machinability.

The chief difficulty encountered in the machining of iron castings is due to hard spots or chilled portions. Machinability, in such cases, can be improved by increasing silicon, but at the expense of good structure and mechanical properties. Machinability can be facilitated while still retaining the advantage of low silicon by adding nickel in order to eliminate chill and hard spots. Table III shows some typical examples where this method has proved advantageous. While there is no definitely established relation between machinability and hardness, it is generally known that the harder an iron casting the more difficult it is to machine. Although increased strength can be obtained by adding carbide-forming alloying elements, it has been found advisable to supplement their effect by the addition of graphitising alloying elements, such as nickel, in order to facilitate machinability. In many instances, when carbide areas occur due to the addition of chromium, the addition of molybdenum will improve machinability by causing the carbides to disperse. Commercially machinable castings in the Brinell hardness range from 300 to 320 and are obtained by addition of nickel alone or in combination with other elements in such proportions that excess carbide is reduced or eliminated.

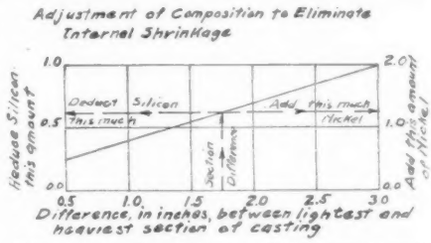


FIG. 3.—ADJUSTMENT OF SILICON AND NICKEL REQUIRED TO ELIMINATE INTERNAL SHRINKAGE IN CASTINGS WITH VARYING THICKNESS OF SECTION.

TABLE I.—*Typical Applications of the Use of Nickel, Nickel and Chromium and Molybdenum in the Refinement of Grain of Castings.*

Application	TC	Mn	P	S	Si	Ni	Cr	Mo	Thickness of sections
Generator shells and caps	old 3.40 new 3.20	0.60 0.60	0.55 0.30	0.10 0.12	2.60 1.40	1.50			¾" to 1½"
Paper Machinery Rolls	old 3.30 new 3.10	0.55 0.60	0.30 0.15	0.09 0.12	1.58 1.25	0.05 1.00	0.10 0.35		1" to 4"
Machine tool bed	old 3.25 new 3.10	0.60 0.55	0.40 0.30	0.09 0.12	2.00 1.00	0.75			¾" to 3"
Grey iron patterns	old 3.30 new 3.30	0.50 0.50	0.50 0.50	0.07 0.07	2.40 2.40	1.25	0.50		Not known
Drier rolls (paper machinery)	old 3.40 new 3.10	0.60 0.60	0.45 0.25	0.10 0.10	2.25 1.30	1.50			1½" to 4"
General machinery castings	old 3.60 new 3.30	0.70 0.65	0.45 0.24	0.11 0.12	1.50 1.10	0.92			1" to 3"
Hot water heater	old 3.30 new 3.30	0.60 0.60	0.25 0.25	0.10 0.10	1.30 1.30			.50%	½" to 2"

Increased Hardness and Resistance to Wear.

Ferritic irons are soft and wear rapidly. This was clearly demonstrated by tests made for the U.S. Navy Department.[4] As hardness increases the structure of a casting changes to complete pearlite, and resistance to wear increases progressively. If Brinell hardness of plain iron be increased much beyond 210, the structure will consist of pearlite and some iron carbide, and resistance to wear will then decrease. If the structure of an iron can be hardened (by sorbitising) above 210 without the formation of free carbide then resistance to wear can be increased still further. This effect is shown in Fig. 5. Other typical examples are shown in Table IV. It has been very difficult to obtain exact figures on rates of wear of automobile cylinders, but several producers have stated that the use of alloying elements have increased resistance to wear in alloyed cylinder blocks two to seven times that of plain-iron blocks.

High-Test Cast Iron.

Under this heading discussion will be limited to cast iron the strength of which is included within the range of 17.8 tons/sq. in. to 22.3 tons/sq. in. These irons can be consistently produced by regular grey-iron foundry practice. Higher-strength irons with tensile strengths above 22.3 tons sq. in., which are manufactured by special processes, will be described later under a separate heading. High-test cast irons are produced in America by the cupola, air-furnace and electric-furnace processes. It has not been possible to obtain data as to the proportionate tonnage produced by each method, but during the last three years electric-furnace production has increased appreciably. It is generally known that the following fundamentals are characteristic of high-test cast iron:—

(1) Total carbon must be low (under 3.20 per cent.) in order that the volume of graphite be as low as possible, consistent with good fabricating conditions, and (2) graphite particles must be as small in size and as evenly distributed as possible.

These two requirements are usually fulfilled by melting low-carbon pig-iron or steel scrap as a substantial portion of the furnace charge. In cupola melting, steel scrap takes up from 40 to 85 per cent. of the total furnace charges. The details of cupola melting are too extensive to be included in this Paper. Various alloying

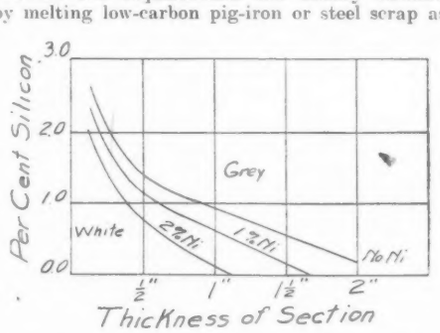


FIG. 4A.—MINIMUM SILICON AND NICKEL CONTENTS REQUIRED TO PRODUCE A GREY FRACTURE IN DIFFERENT THICKNESSES OF SECTIONS IN CASTINGS CONTAINING 3.4 PER CENT. TO 3.6 PER CENT. TOTAL CARBON.

[4] "Properties and Heat-Treatment of Cast Iron for Diesel Engines": F. B. Coyle, Trans. A.S.S.T., Sept., 1927, p. 453.

elements or combinations of them are often used in high-test cast iron in order to:—

(1) Extend the range of base composition which will give maximum strength;[5] (2) refine grain, increase hardness and density as well as wear resistance, and (3) improve uniformity of structure and physical properties throughout sections of large cross-section.

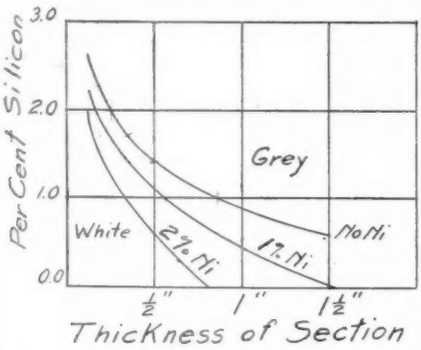


FIG. 4B.—MINIMUM SILICON AND NICKEL CONTENTS REQUIRED TO PRODUCE A GREY FRACTURE IN DIFFERENT THICKNESSES OF SECTION IN CASTINGS CONTAINING 3.25 PER CENT. TO 3.4 PER CENT. TOTAL CARBON.

The effect of adjusting base composition with addition of alloying elements is shown in Table V. Standard compositions of nickel and nickel-chromium high-test cast iron of various combinations of physical and mechanical properties which are extensively used in America are given in Table VI. Other typical compositions and tests of arbitration test-bars of high-test cast iron in use in America are shown in Table VII.

TABLE II.—*Applications Involving the Reduction of Silicon with Addition of Nickel in Order to Eliminate Internal Shrinkage.*

Application		TC	Mn	P	S	Si	Ni	Thickness of sections
Bread and Candy mixer heads	old	3.30	0.65	0.20	0.075	2.00		Not known
	new	3.10	0.60	0.18	0.09	1.50	1.00	
Molding machine cylinders	old	3.40	0.60	0.43	0.125	1.75		1" to 2½"
	new	3.40	0.50	0.29	0.135	1.25	1.00	
Ammonia valves	old	3.50	0.66	0.20	0.08	2.40		½" to 1½"
	new	3.25	0.65	0.20	0.09	2.00	1.00	
Expansion joints	old	3.50	0.55	0.60	0.09	2.40		½" to 2½"
	new	3.40	0.60	0.25	0.135	1.25	2.00	
Engine base	old	3.40	0.60	0.60	0.10	2.25		1½" to 4"
	new	3.10	0.65	0.30	0.10	1.25	1.50	
Steam chest for clothes pressing machine	old	3.40	0.45	0.60	0.08	2.25		¼" to 1½"
	new	3.30	0.65	0.20	0.10	1.40	1.00	
Air compressor	old	3.25	0.62	0.20	0.08	2.10		5/8" to 1½"
	new	3.02	0.62	0.18	0.08	1.90	0.75	

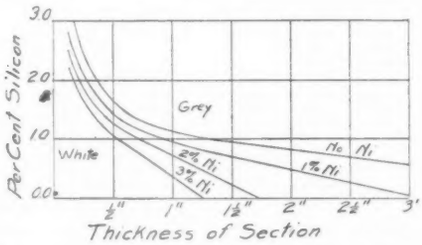


FIG. 4C.—MINIMUM SILICON AND NICKEL CONTENTS REQUIRED TO PRODUCE GREY FRACTURE IN DIFFERENT THICKNESSES OF CASTINGS CONTAINING 3.1 PER CENT. TO 3.25 PER CENT. TOTAL CARBON.

[5] Coyle: "Static Strength of Plain and Alloy Cast Iron," Pro. A.S.T.M., Vol. 29, Part II, 1929.

Throughout the text and tables, unless otherwise stated, all transverse and tensile tests were made on test-bars 1¼ in. in diameter cast 15 in. long. Transverse tests were made on 12-in. centres. In order to afford uniform comparison, tests originally made on 1.2-in. by 18-in. bars have been converted to the equivalent of 1¼-in. by 12-in. bars. This has been done because, though the American Society for Testing Materials has adopted the 1.2-in. by 18-in. bar as standard, many American foundrymen have been reluctant to change from their former testing procedure.

Heat-Treated Alloy Cast Iron.

The process of heat-treatment of cast iron has been used in America for many years. However, the principal methods used until recent years have been artificial ageing for relieving casting stresses and annealing to facilitate machining. A small amount of castings were also treated by quenching or quenching followed by tempering. During the last five years the heat-treatment of iron castings, particularly those containing alloys, has been extended widely.

Artificial ageing is applied to a limited extent to automobile cylinder blocks, cylinder heads and pistons. Practically all Diesel-engine cylinders, liners, cylinder heads and pistons are aged by thermal treatment. General machinery castings requiring machining to fine limits of dimension are also artificially aged. However, during the last few years one manufacturer of automobile cylinder blocks and several producers of heavy machine-tool beds have added 1.5 to 2.0 per cent. nickel to their castings, which by stimulating uniform structure has reduced casting stresses to such an extent that artificial ageing is unnecessary. Molybdenum has also been employed to a limited extent for this purpose. Ageing is usually performed within the temperature range 427 deg. C. to 597 deg. C.

Annealing.

Annealing is now conducted for four specific purposes:—(1) Annealing grey iron for softness to facilitate machining. This is carried on at 760 deg. C. or above. Where maximum machinability is the sole factor, the addition of alloying elements has been found to be detrimental, since they increase hardness; (2) annealing martensitic white iron between 597 deg. C. and 649 deg. C. to permit machining (this will be discussed later under alloy white iron); (3) annealing white, plain or alloy cast iron between 871 deg. C. and 927 deg. C. to impart toughness and resistance to impact to castings (this will also be described at length under alloy white iron); and (4) partial malleabilising of alloy white cast iron in order to obtain increased tensile strength and promote ductility (this will be described fully under high-strength cast iron).

Quenching of cast iron is usually resorted to in order to obtain maximum surface hardness. In some instances castings are used in the quenched condition, but in many cases they are tempered between 100 and 204 deg. C. in order to relieve quenching stresses without material reduction in hardness. The effect of composition on response to hardening treatment of plain and alloy cast irons is shown in Fig. 6. These data show that:—(1) The lower the silicon in plain or alloy iron (other things being equal), the greater the response to hardening treatment; (2) the lower the carbon in plain or alloy iron (other things being equal), the greater the response to hardening treatment; (3) the addition of nickel to iron, without further changes in composition, increases the response to hardening treatment; (4) the addition of nickel and chromium in the proportion of two to three parts of nickel to each part of chromium (other things being equal) results in maximum obtainable hardness; and (5) it is possible consistently to obtain Brinell hardness above 500 with nickel and nickel-chromium irons of suitable total carbon and silicon content by quenching in oil from above the critical range on heating.

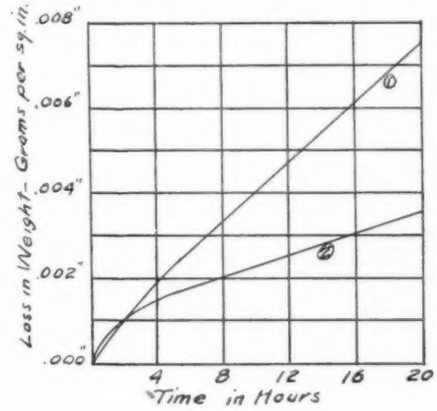


FIG. 5.—RELATIVE WEAR OF 1¾-IN. DIA. DISCS ROTATED IN SALT SOLUTION.

Composition.	No. 1.	No. 2.
Total carbon	3.40	3.42
Combined carbon ..	0.45	0.52
Manganese	0.70	0.77
Phosphorus	0.30	0.25
Sulphur	0.08	0.06
Silicon	2.20	2.28
Nickel	None	1.23
Chromium	None	0.21

Silicon is so high and manganese relatively high in cast iron that water quenching is too drastic (except for castings of very heavy section), and tends to cause checks or fine cracks on the surface of pieces treated. Castings with sections of moderate thickness and simple shape are usually quenched in oil from about 28 deg. C. above the upper end of the critical range on heating. Castings with thin sections and complicated shapes are usually cooled in still air from 56 deg. C. or 84 deg. C. above the upper end of the critical range on heating.

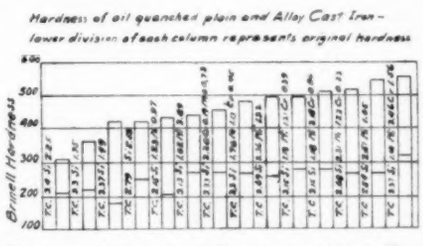


FIG. 6.—HARDNESS OF PLAIN AND ALLOY CAST IRON BEFORE (LOWER DIVISION) AND AFTER QUENCHING IN OIL FROM 50 DEG. FAH. (10 DEG. C.) ABOVE THE CRITICAL RANGE. COMPOSITIONS IN TABLE IX.

An added advantage of the use of alloying elements in heat-treated iron castings (particularly of heavy section) is shown by improved depth-hardening properties. This is illustrated in Fig. 7, which shows the results of quenching tests on 3-in. rounds. The compositions of these irons are given in Table VIII. These data show that:—(*a*) Adding nickel and chromium increases both depth hardness and surface hardness considerably; and (*b*) low total carbon and high nickel and chromium content produces greatest depth hardness and surface hardness.

Table III.—*Typical Examples of Improvement of Machinability Due to Addition of Nickel.*

Application		TC	Mn	P	S	Si	Ni	Thickness of Sections	Remarks
Expansion joint	old	3.35	0.50	0.25	0.15	1.20		¼" to 1"	Machining time reduced 25%
	new	3.35	0.50	0.25	0.15	1.20	1.00		
Gears without teeth*	old	3.40	0.65	0.45	0.10	1.55		not known	Machining time per piece cut from 9 hrs. to 5½ hrs.
	new	3.40	0.65	0.45	0.10	1.25	0.50		
Tractor rings	old	3.35				2.10		½" to ¾"	Tool saving £5.00 per day
	new	3.35				2.10	0.50		
General machinery	old	3.35	0.65	0.20	0.10	2.00		½" to 1¼"	Elimination of chill effected large saving in cost of machining
	new	3.35	0.65	0.20	0.10	2.00	0.50		

* Reduction in Silicon also necessary to eliminate internal shrinkage.

Nickel-chromium cast-iron dies are successfully used for pressing novelty coins and identification tags and discs when high finish and exact sharpness of outline are not essential. In the hardened state, they possess fine close-grained finish, resist wear and are more economical than expensive die steels. A representative composition follows:—Total carbon, 2.75; silicon, 0.75; nickel, 2.00; and chromium, 1.00 per cent.

Hardening Treatment.

It is essential that pressing dies be given a hardening treatment after the impression is prepared. A water-quenching treatment will develop great hardness, but an oil-quenching treatment will, with a slight sacrifice in hardness, obviate possibilities of cracking during quenching. The following treatments have been used:

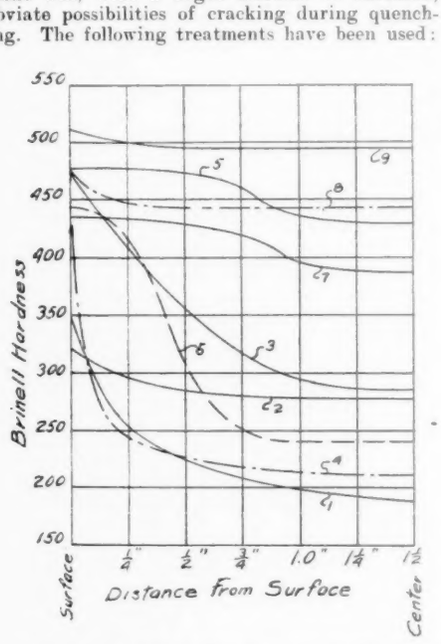


Fig. 7.—Hardness from Surface to Centre of 3-in. dia. Bars quenched in Oil from 50 deg. Fah. (10 deg. C.) above the Critical Range. Compositions in Table IX.

(*a*) Heat at 788 deg. C., 1 hr. for each inch in thickness, quench in water and reheat in boiling water to relieve stress; and (*b*) heat at 843 deg. C., 1 hr. for each inch in thickness, quench in oil, and reheat in boiling water to relieve stress. Quenched nickel or nickel-chromium alloy iron castings are also used for shoe-levellers and cams in shoe-machinery and for cams in food-canning machinery and for roller-bearing races.

Quenching followed by Tempering.

During the past three years the heat-treatment of alloy cast iron by quenching and tempering has been extensively adopted for drawing dies, motor-lorry sleeves, Diesel-engine and locomotive-cylinder liners, and machine-tool parts. The effect of quenching and tempering on the Brinell hardness of various plain and alloy cast irons is shown in Fig. 8. The compositions of these irons are listed in Table VIII. It is evident that the lower the silicon content and the higher the alloy content, the higher is the tempering temperature required to obtain an identical hardness number. The higher the alloy content, the higher the hardness for a given tempering temperature. The hardness of high-alloy irons diminishes but little upon drawing at temperatures up to 347 deg. C. Above this temperature the hardness of these irons diminishes rapidly upon tempering at temperatures up to 649 deg. C.

The effect of quenching and tempering upon the tensile strength of the irons listed in Table VIII is shown in Fig. 9, which indicates that:—(*a*) The tensile strength of plain and alloy cast iron is decreased 15 to 50 per cent. by quenching in oil. Irons of high nickel-chromium content show least falling-off in strength due to quenching; (*b*) tempering at 204 deg. C. restores the tensile strength to its original value, while higher tempering temperatures (up to about 427 deg. C.) show an improvement over the original tensile strength; and (*c*) the best combination of good strength with Brinell hardness above 300 can be obtained in castings containing over 3.0 per cent. nickel and 0.75 to 1.5 per cent. chromium by quenching in oil and tempering between 427 and 538 deg. C.

Heat-treated alloy cast-iron dies are extensively used in the automobile industry in processes forming sheet-metal parts, because they are strong and hard, yet machinable; possess a fine grain and assume a high polish; eliminate galling and streaking of metal formed; wear longer than plain iron dies; and are economical.

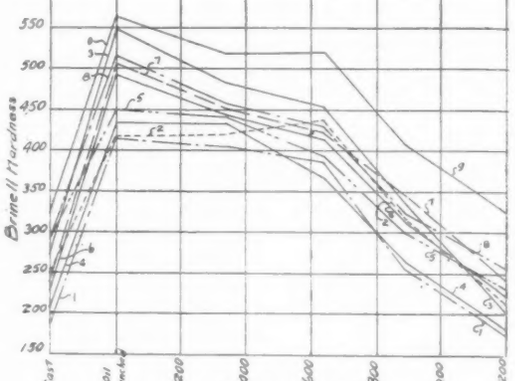


Fig. 8.—Effect of Quench and Draw Back on the Brinell Hardness of Compositions given in Table IX.

Sheet-working methods vary considerably. In some instances draft is slight and corners widely rounded. In other instances draft is deep and corners sharp. The gauge of sheet metal (thick or thin) worked is also important. For this reason a number of compositions (each suitable for a particular purpose) have been used successfully, as shown in Table IX.

Type 1 is used for light duty; that is, pressing thin sheet with light draft and full curves, such as bodies and fenders of light cars; whilst *Type* 2 is used for medium-duty work and relatively deep pressing. The silicon and chromium contents are varied according to the thickness of the dies. In very thick dies the silicon is low and the chromium high. When high strength (over 18 tons per sq. in. tensile strength) is desired, the carbon is reduced to the lower portion of the range. Nickel-chromium iron of this grade has pressed 16,000 to 18,000 fender and body blanks, where under the same conditions only 3,000 blanks were made by plain-iron dies. As many as 50,000 chassis channel-blanks have been pressed. In one instance, heat-treated dies of this grade gave the same performance as a high-grade die steel, at a material cost of only one-tenth that of steel.

Type 3 is the "Ni-Tensyliron" grade, with a tensile strength greater than 22 tons per sq. in., and is successful not only for all types of work but heavy duty in particular. Accurate records show 126,000 fender and body sheets have been

(*Continued on next page.*)

Table IV.—*Typical Examples of Superior Wear Resistance of Alloy Cast Iron Over Plain Cast Iron.*

Application		TC	Mn	P	S	Si	Ni	Cr	Ave. BHN	Wear Data
Tractor cylinder bushings	old	3.26				2.20			160	.010" after 49,000 Miles
	new	3.20				1.90	1.25		200	.004" " " "
Cams	old	3.30				1.50			170	Life was 4 months
	new	3.30				1.40	3.00		240	" " 24 "
Clutch plates	old	3.20				1.50			196	Life was 2 to 3 weeks
	new	3.20				1.75	1.5		203	" " 22 weeks
Gears (brick plant)	old	3.25	.60	.45	.09	1.75				Life was 10 months
	new	3.25	.60	.45	.09	1.75	5.0			" " 24 "
Forming dies	old	3.00				1.00			190	12,000 impressions before dressing
	new	3.00				1.25	2.75	0.70	250	140,000 impressions before dressing
Automobile cylinder blocks	plain	3.15	0.65	0.11	0.12	2.35			200	.00075" after 240 hrs
	Cr.	3.15	0.65	0.11	0.12	2.35		0.37	210	.00050" " operation
	Ni Cr	3.15	0.65	0.11	0.12	2.35	1.12	0.23	217	.00025" " " "

National Physical Laboratory.

The annual inspection by the general board of the National Physical Laboratory, Teddington, took place on Tuesday, June 27, an opportunity being provided for witnessing in progress much of the important work being carried on in the various departments.

In connection with aerodynamics, a new compressed-air tunnel has been installed, in which a wind speed of about 60 miles per hour can be attained at about 25 atmos. pressure, and this wind, blowing upon a model of $\frac{1}{10}$ scale, will simulate the conditions of a full-scale machine flying at 150 miles per hour. The vessel containing the tunnel is 50 ft. long and 17 ft. internal diameter. The steel is $2\frac{1}{2}$ in. thick and the tunnel weighs 310 tons. The containing building had to be erected after the tunnel was assembled in position. The pressure attainable is 350 lbs. per sq. in. and the end castings have each to withstand a total pressure of about 5,000 tons.

In the Engineering Department experiments are being carried out on air injectors and the factors affecting their performance, which are as yet not well understood. The results should have important bearings on industrial processes involving the air conveyance of materials such as cement, powdered coal, etc. In the air injector, as used in many industrial processes, a stream of air of lower speed and greater volume is drawn along by the inductive action of a jet of air of much higher speed. In recent work the Laboratory has succeeded in producing in this way an air stream with speeds up to 1,000 miles an hour.

Regarding the ship tanks in the William Froude Laboratory, it may be mentioned that the older Alfred Yarrow Tank, completed in 1911, is 550 ft. long, and the new tank opened by Mr. Baldwin in November, 1932, is 678 ft. long; the latter is capable of higher speeds and is more suited to work on fast ships, etc. With these two tanks, and the tunnel for research on ship propellers, which is at present under construction (the funds for which have been presented by Sir James Lithgow, Bart.), the Laboratory is probably better equipped for the study of ship propulsion than any other institution in the world. The research work carried out in the Alfred Yarrow Tank has had far-reaching effects on ship design, among which may be mentioned the introduction of the cruiser stern on merchant vessels (which has reduced resistance); the introduction of aerofoil type propellers (which has increased propeller efficiency); the use of a central fin on single-screw ships to control flow into the propeller (which has further increased efficiency and improved steering); and the change of rake now common in the single-screw ships (which tends to reduce vibration).

In the Metallurgy Department work for the British Non-Ferrous Metals Research Association was in progress, dealing with the study of distribution of impurities in large ingots of copper and the macrostructures of ingot sections. Other items of interest included apparatus for determining electric resistivity of molten metals and apparatus for electro-deposition of iron on the surfaces of fracture of test pieces, etc. Methods of study of the mechanism of flow and fracture of metals under prolonged stress at high temperatures were demonstrated, and one was able to inspect prolonged loading tests of five-years' duration on boiler-plate steel at 300 deg. C. Equipment for X-ray studies of metals and alloys—cameras and spectrometer were also on view, and spectroscopic analysis was also demonstrated.

Scale of Corrosion.—In "Bautechnik," H. HEBBERLING proposes a scale of corrosion based on observational data, and discusses the advantages of a scientific classification of the various corrosion phenomena.

Coming Scrap Shortage?

By "ONLOOKER."

The steady improvement in the iron and steel trade is being reflected in a reduction of reserves of ferrous scrap all over the country, stocks at the yards of merchants and dismantling contractors now being lower than for a long time past. The same thing is happening with the non-ferrous group, but here we find that there is a tendency on the part of holders to await better prices, and, in consequence, old brass and copper are not coming on to the market very briskly. In the early part of this year there was a fairly general impression that large quantities of brass and copper scrap were being held up awaiting a better selling level, and on the advance in values of copper and spelter a moderate tonnage has been released, but the quantity has not come up to expectations.

The question now arises as to whether anything like so much scrap is actually available as was anticipated when the quotations for copper and spelter were standing very much lower than they are to-day, and, judging by the reports from merchants and dealers who are striving to obtain material to trade to consumers, one is forced to the conclusion that the quantity available is not very great. Scrap is being held up, of that there can be little doubt, and since sentiment in regard to metals, and, indeed, with reference to all commodities, is now in the main "bullish," it seems more than likely that those people who are holding scrap will continue to hold it. In the long run, no doubt, they will miss their market, but at the present time, with the prospect of still further inflation ahead, there is very little chance of persuading these traders that their best interests lie in keeping in touch with buyers while the rise is in progress and releasing at least part of their stock.

Recent figures show that Germany's consumption of scrap has been increasing for some years past, the greater part of this additional material having been provided by America; although reserves in this country have also been drawn upon fairly freely. This drain, especially of brass scrap, has been particularly noticeable this year, and big prices have been paid by dealers, much to the annoyance of consumers in this country, who have in consequence found it difficult to cover their needs at reasonable prices. The bulk of the material going abroad has, it is true, been low-grade stuff, but values in scrap, as in everything else, are relative, and the broad effect has been to lift values all round.

Scrap metal has been described as the reject from the manufacturing system, and on the basis of this argument it is obvious that the past few years, with their severe decline in trading activity, must have put a check on the tonnage of old metal becoming available for use. No particular hardship comes from this so long as trade remains stagnant, but when the wheels begin to turn again more freely there is an interim period when demand definitely outstrips supply and reveals a scarcity. Upon such a period we are now embarking, and it is not at all unlikely that many months will elapse before the ratio is adjusted and scrap becomes more plentiful again. To estimate events very far ahead nowadays is notoriously difficult, but it rather seems as if the autumn will prove to be the time when this threatened scarcity of scrap becomes most obvious.

The shortage is likely, of course, to be sectional in its incidence, and even now it is evident that supplies are shorter in some directions than others. Reference has been made to scrap going abroad, and the bulk of this is swarf and turnings, as a result of which ingot makers and others who rely upon this class of stuff for their raw material are suffering considerable

(*Concluded in next column.*)

American Progress in the Use of Alloys in Cast Iron.

(*Continued from previous page.*)

pressed by dies of this grade, whilst only 12,000 were pressed by dies of Grade 1. Redressing time of *Type* 3 dies was only 3 hrs. and that of Grade 1 dies 26 hrs.

Type 4 is applicable especially for extreme heavy duty. This grade, heat-treated, was still

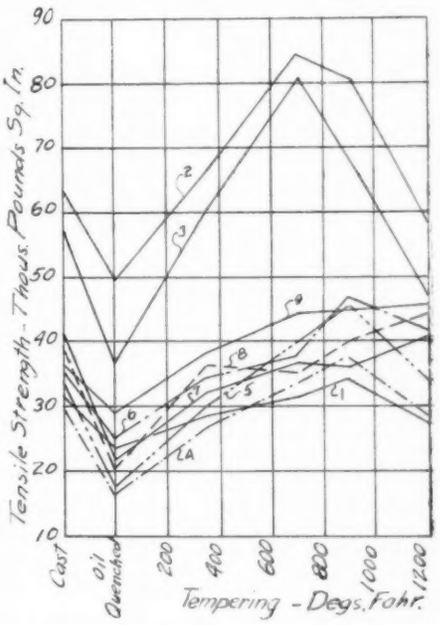


FIG. 9.—EFFECT OF QUENCH AND DRAW BACK ON THE BRINELL HARDNESS OF COMPOSITIONS GIVEN IN TABLE IX.

serviceable after pressing over 8,300 steel brake-drums, whereas *Type* 2 nickel-chrome-iron dies were unserviceable after 1,500 presses and plain iron was unserviceable after 800 presses.

(*To be continued.*)

Duncan Stewart-Demag Corporation, Limited.

Messrs. Duncan Stewart & Company, Limited, of Glasgow, in association with Demag, A.-G., of Duisburg, have formed a new company under the title of the Duncan Stewart-Demag Corporation, Limited, which will manufacture in this country steelworks and rolling-mill plant to Demag designs. Under this arrangement the new corporation will have the benefit of combined British and Continental practice in the manufacture of steelworks plant. The Duisburg concern will supply the drawings and the manufacture will be undertaken in this country with British labour. The London office of the Duncan Stewart-Demag Corporation, Limited, is at 54, Victoria Street, London, S.W.1.

Mr. Ernst Hafels continues his representation of the Demag, A.-G., in this country at his office at 12, Victoria Street, London, S.W.1, independently of the new corporation.

(*Concluded from preceding column.*)

inconvenience. In brass generally the scarcity is more noticeable than in copper, for American shipments of old rolled, pipes and tubes and extruded sections have been suspended for months past. Copper is more plentiful, and of heavy copper scrap there is something like a glut if the total tonnage available be considered in conjunction with demand. This only applies to heavy copper, however, for dealers are finding it difficult to secure sufficient wire to satisfy customers' needs.

This Week's News in Brief.

Trade Talk.

IN PREPARATION for the annual holidays, the Carron Company's works holiday fund was paid out on June 27, amounting to £4,181.

THE ROPNER SHIPPING COMPANY, LIMITED, West Hartlepool, announce a scheme to recondition a portion of their fleet at an estimated cost of over £50,000.

SUGAR-MACHINERY WORKS on Clydeside are working full time, largely owing to a series of orders recently placed for plant and equipment for sugar factories in India.

MESSRS. HOLMAN BROS., LIMITED, engineers and ironfounders, were awarded first and special prizes for the best undecorated horse and wagon in the recent Camborne Carnival.

EIGHT LOCOMOTIVES and tenders built by the North British Locomotive Company, Limited, Glasgow, will be shipped to China from Stobcross Quay, this week. The engines are intended for the Tientsin-Pukow Railway.

A DIESEL-ELECTRIC express train is now nearing completion at Scotswood, Newcastle-upon-Tyne. It was ordered as a complete unit from Sir W. G. Armstrong Whitworth & Company, Limited, and is being built for the San Paulo Railway of Brazil.

AT AN EXTRAORDINARY GENERAL MEETING, registered holders of the 6 per cent. first debenture stock of the Consett Iron Company, Limited, approved by a large majority the proposals announced recently for a temporary reduction in interest and postponement of redemption provisions.

ON JUNE 13 the Soviet blast furnaces produced 22,242 metric tons of pig-iron—a new record. Since June 2 the daily output has exceeded 20,000 tons, although the proposed output was 24,000 tons per day. The shortage is due to the low outputs and inefficiency of ironworks in South Russia.

THE BRAZILIAN GOVERNMENT has provisionally accepted the tender of the Metropolitan-Vickers Electrical Company, Limited, to electrify 103 miles of the Central Railway from Rio de Janeiro to Sao Paulo. The cost is estimated at £3,000,000, and payments are to be made over a period of five years.

MINING & INDUSTRIAL EQUIPMENT, LIMITED, 11, Southampton Row, London, W.C.1, report the receipt of orders from home and foreign firms for three Hardinge mills, two "Impax" pulverisers, five Hum-mer screens, a Rovac filter, three Ro-Tap testing sieve shakers, and one five-roller Raymond mill.

THE CHILEAN GOVERNMENT has made a grant of £1,000,000 for the development of the country's iron and steel industry. The Corral and Valdivia works are to be developed, and are intended to cover the whole iron and steel requirements of Chile. The ore deposits of Chile are adequate to meet the whole of the present demand.

THE ENGLISH ELECTRIC COMPANY, LIMITED, held their annual inter-works sports at Stafford on Saturday, June 24. Stafford and Bradford Works shared the aggregate cup with 11 points each. Nearly 300 employees made the journey from Rugby, Bradford and Preston, and were accorded a civic welcome on behalf of the Borough of Stafford.

AN ORDER for a new passenger and cargo steamer has been placed by the Dundee, Perth & London Shipping Company, Limited, with Messrs. the Caledon Shipbuilding & Engineering Company, Limited, Dundee. The new vessel is for service between London and Dundee, and will be 280 ft. long, with a speed of 13½ knots. The engines and propelling machinery will be constructed by Messrs. Alexander Stephen & Sons, Limited, Linthouse, Glasgow.

A VESSEL OF GREAT INTEREST was launched on June 29 from the yard of Messrs. Hall, Russell & Company, Limited, Aberdeen. She is a pioneer vessel, being the first British electric tug, and she has been constructed to the order of Messrs. Robinson & Crosthwaite, Middlesbrough. The vessel is 90 ft. long by 22 ft. beam, and the machinery installed by the builders consists of two Brotherhood Ricardo Diesel engines manufactured by Messrs. Peter Brotherhood, Limited, Peterborough. The electrical equipment has been supplied by the General Electric Company, Limited.

EIGHTEEN UNIONS in the shipbuilding and engineering trades of the Clyde have launched a campaign for a 40-hr. week. In their inaugural announcement the unions state that the working week in the engineering and shipbuilding industries of the Clyde was reduced from 54 to 47 hours in 1919 without reduction in wages. They claim that the time is now opportune for a further reduction of seven hours, again without wage reduction. The national executives of the unions are expected next week to enter into negotiations with the national executive of the Shipbuilding and Engineering Employers' Association regarding a national demand for a 40-hr. week in the industries.

AN IMPORTANT MERGER has been drawn up with the object of consolidating and reconstituting the iron and steel industry on the North East Coast. The companies concerned are Dorman, Long & Company, Limited, the South Durham Steel & Iron Company, Limited, and the Cargo Fleet Iron Company, Limited, and subject to its debenture and shareholders accepting a capital reorganisation scheme, which is put forward simultaneously with the merger plan, Dorman, Long will acquire the South Durham and the Cargo Fleet companies. The amalgamation is designed to prevent competition and to eliminate obsolete or redundant plant and to secure the progressive concentration of production in the more efficient plants. Further details of the scheme will be published in our next issue.

FALKIRK WORKERS set off for the annual summer holidays on June 30 in a happier frame of mind than of recent years, owing to the fact that lately there has been a distinct revival in the light-castings industry. The works will resume on July 10, a shorter break than has been the case of recent years. The improvement in trade is also reflected in the fact that within the last three months the number of workers in receipt of idle benefit from the Ironfounding Workers' Association has dropped from 1,200 to 570. In three years the Association paid out over £42,000 in benefit, and the drain was such that, had it continued for a short period longer, it would have been necessary to suspend benefit entirely. The income in the past three months has, however, been sufficient not only to cover outlays, but to provide a surplus to go to the Association funds.

Company Reports.

Davy Bros., Limited.—Debit balance brought in, £111,032; loss for year ended March 31 last, £5,487; debit balance carried forward, £116,520.

James Keith & Blackman Company, Limited.—Credit balance, after providing for preference dividend and making allowance for depreciation and reserves against doubtful debts, £23,255; dividend on the ordinary shares of 8 per cent., £12,000; carried forward, £11,255.

Barrow Hematite Steel Company, Limited.—Two sets of accounts show the position on July 26, 1932, and on December 31 last, indicating how each asset was written down at the date the reconstruction scheme became effective, namely July 26, 1932. A loss of £10,158 shown for the last five months is due to the fact that the blast furnaces and steelworks only operated for a short period, it being found necessary to liquidate stocks which had accumulated in the earlier part of the year. For the period January 1, 1932, to July 26 last, the loss, after payment of debenture and other interest, taxes, etc., was £18,013, plus debit of £54,065 brought in, making £72,078. This amount was written off under the scheme of arrangement, which wrote off £1,005,544 of the fixed assets, reducing these to £919,950.

Contracts Open.

Lahore, July 17.—Oil-engined rail motor-car, for the North-Western Railway. The Department of Overseas Trade. (Reference G.Y. 12,682.)

Margate, July 17.—10-ton crude-oil-driven road roller, for the Corporation. Mr. E. A. Borg, borough surveyor, 40, Grosvenor Place, Margate.

Johannesburg, August 14.—38 rail motor-trolleys, for the South African Railways and Harbours. The Department of Overseas Trade. (Reference G.Y. 12,697.)

Kidderminster, July 8.—600 yds. of 4-in. and 1,365 yds. of 3-in. cast-iron water pipes, etc., for the Kidderminster Rural District Council. Mr. A. S. Northover, surveyor, Central Chambers, High Street, Kidderminster.

Personal.

MR. G. C. CASTLE has resigned his directorship of Beecroft & Partners, Limited, and British Foundry Units, Limited, and is now handling all types of foundry plant, equipment and supplies from 59, Brookhouse Hill, Sheffield, 10.

MR. JOHN O. MCLAREN, President of the McLaren Soc. Anon., Casilla de Correo, 2082, Buenos Aires, will arrive in London on July 14, and expects to remain in Europe about four months. We understand that he will be interested in all foundry specialities.

MR. H. M. GLASS has resigned from the position of shipbuilding director on the board of Messrs. Barclay, Curle & Company, Limited, Glasgow, from June 28. Mr. Glass joined the board in 1928 and was previously general manager with Messrs. Workman, Clark & Company, Limited, Belfast.

DR. J. H. DOBSON has been appointed general works manager of the South Africa Iron & Steel Industrial Corporation, Limited, Pretoria. Dr. Dobson has been associated with the Corporation, directly and indirectly, from its inception, having been appointed in 1928 as one of the first directors. In November, 1930, he was nominated by the South African Iron & Steel Industrial Corporation as the chairman of the Union Steel Corporation, which position he occupies at the present moment.

THE LATE Mr. William Shaw, of Saltburn, steel founder and managing director of W. Shaw & Company, Limited, of the Wellington Cast Steel Foundry, Middlesbrough, President of the Middlesbrough Branch of the Institute of British Foundrymen, 1930-31, whose death was reported in our issue of May 18, left an estate of the gross value of £194,737, with net personalty £186,662. Shortly before his death Mr. Shaw prepared a codicil to his will, and though this was not executed, the provisions will be carried out by family agreement. This codicil, in addition to charitable bequests, set up a fund for the relief of the needs of any present or future employee of W. Shaw & Company, Limited. This fund is to be administered by a committee on which the employees are represented.

MR. J. W. BARON, who for the past 21 years has held the position of chief buyer to Leyland Motors, Limited, has relinquished his appointment and retired on June 30, much to the regret of his directors and colleagues. Mr. Baron joined the Leyland staff 25 years ago, and clearly recalls the days when the output rarely exceeded three vehicles per week, and when the number of the general staff was very different to that which it is to-day. Coming into contact, as he did, with so many suppliers of material during his long term of service, he was very well known in the trade and much respected. We feel sure that his many friends will join those of Leylands in wishing him long life and happiness in his retirement. The vacancy created by his retirement will be filled by Mr. W. J. Cox, who will act as chief buyer to the company as from July 1.

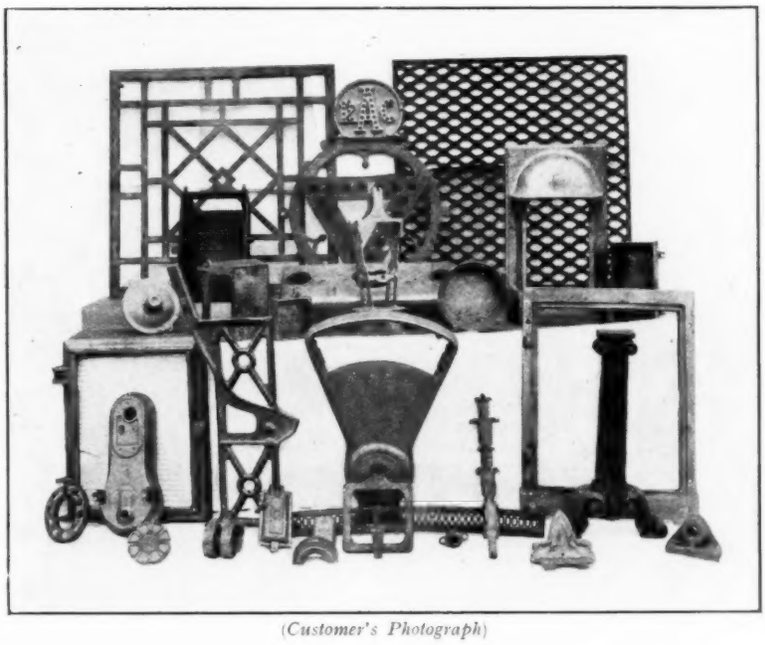
Obituary.

MR. JAMES SANDERSON, a former employee of the Falkirk Iron Company, Limited, and a very prominent figure in business and social circles in Falkirk, suddenly collapsed and died on June 28.

Motor Coach Stations.—The British Steelwork Association has issued a well-illustrated brochure describing some typical examples of modern motor coach stations in which extensive use has been made of structural steelwork. The stations illustrated are the Victoria coach station for London coastal coaches; King's Cross motor coach station; the Smithfield Bus Station, Belfast; Green Line coach stations; the Bournemouth coach and omnibus station, and the London Terminal coach station at Kennington.

FRODAIR PIGIRON

Best after Test —



(Customer's Photograph)

ALL TYPES OF CASTINGS TURNED OUT EQUALLY PERFECT— FOR THE PAST 50 YEARS TOO !

APPLY FOR PARTICULARS:—

FRODAIR IRON & STEEL Co., Ltd., FENCHURCH HOUSE, LONDON.

Raw Material Markets.

The improved tone in the iron and steel markets is maintained, in spite of the restricted export trade. Home consumption keeps up in very satisfactory fashion, although the inactivity largely prevailing in the shipbuilding and heavy engineering industries is still a considerable handicap to the iron and steel trades. Producers of semi-finished steel are enjoying a period of increased activity, following upon the virtual exclusion of foreign material from the home market.

Pig-Iron.

MIDDLESBROUGH.—Business is gradually increasing in this area. Stocks of Cleveland iron have been declining steadily for the past six months and are now stated to be at the lowest level for three years. Hence consumers have thought it wise to enter into forward contracts and a number have been arranged up to September. Another satisfactory feature is that increased deliveries against contracts are being made. Last Friday the prices of Cleveland iron for delivery in Scotland were advanced by 2s. 6d. per ton, quotations now being 65s. 3d. per ton for No. 3 G.M.B. delivered Glasgow area and 62s. 3d. delivered Falkirk. Other quotations are unchanged.

East Coast hematite has been in good demand, and the increase in stocks has been well arrested; indeed, an early reduction is quite possible. A number of big consumers have entered into three-month contracts and prospects for the autumn are now more satisfactory. East Coast mixed numbers are unchanged in price at 59s. per ton f.o.t. or f.o.b. There is little or no underselling by stockholders.

LANCASHIRE.—Light-castings foundries in Lancashire are still fairly busy, particularly those producing builders' ironwork. Other branches of the consuming industries, however, are still underemployed. The Brazilian railway contract provisionally secured by Metro-Vickers should mean increased work in this area. In the meantime, values are maintained on the basis of 67s. per ton for Derbyshire, Staffordshire and Cleveland No. 3, 65s. 6d. for Northants, 62s. for Derbyshire forge, around 80s. for Scottish foundry, and about 75s. and 81s. respectively for East and West Coast brands of hematite, all delivered to users in the Manchester area.

MIDLANDS.—The demand for pig-iron from the light foundries continues to expand, but the call from other directions is still limited. A meeting of the Pig-Iron Producers' Association was held in Birmingham last week, at which the old prices were reaffirmed, namely, 62s. 6d. per ton for Northants No. 3 and 66s. for Derbyshire, Lincolnshire and North Staffordshire No. 3, including delivery to Birmingham and Black Country stations. Cleveland No. 3 is also available at 66s. The demand in the Midlands for medium- and low-phosphorus pig-iron is expanding. Low-phosphorus irons are quoted at between 80s. and 90s., and medium-phosphorus grades are at from 70s. to 85s. Scottish No. 3 is quoted at about 83s. 6d. to 85s. per ton, delivered South Staffordshire. West Coast hematite irons are controlled, and the price for No. 3, delivered, is 84s. 6d. per ton.

SCOTLAND.—The demand for foundry iron in Scotland is decidedly limited and part of the output of the seven furnaces in blast is having to be stocked. The export trade is also very quiet. There is no change to report in prices of Scottish iron; the official minimum of 65s. for No. 3 foundry, f.o.t. furnaces, still operates, with an extra of 2s. 6d. per ton for No. 1 quality. Quotations for Middlesbrough No. 3 have been raised to 65s. 3d. delivered Glasgow and 62s. 3d. delivered Falkirk—an increase of 2s. 6d. per ton. A similar increase has been made in the price of Northamptonshire iron for Scotland, which thus remains at 2s. 3d. below the Cleveland level.

Coke.

Buying interest in the foundry-coke market remains limited, little or no forward purchasing being done. Quotations are unchanged, as follow:—Best Durham coke, 36s. 6d. to 38s.; Scottish coke, 39s. to 40s.; Welsh coke, 30s. to 45s. per ton, according to analysis, delivered in the South Staffordshire area.

Steel.

Steady conditions continue to rule in the steel markets, and the volume of business has been well maintained considering the approach of the slack season, according to the official report of the London Iron and Steel Exchange. The home demand has been on a moderately good scale in most branches of the trade, and although export business is conducted under difficult conditions it shows a tendency to expand. In the semi-finished steel department there has been some revival in Continental competition, and prices below the fixed gold quotations of the Continental works have been accepted by Continental sellers. The British works, however, are fairly well off for orders, and so far the business in Continental material has been confined to a few transactions. In the finished-steel section of the market, business has been comparatively good, and although the demand for shipbuilding material shows little sign of increasing, a fair amount of work is coming to hand from other directions. The demand from overseas is confined to small parcels, but this is a natural result of the restrictions upon exchange which are in force in many markets.

Scrap.

The scrap-iron markets generally have shown a much firmer tone during the past week. In the Cleveland area heavy machinery metal is maintained at 41s. and good ordinary heavy cast iron at 39s. Light metal is firmly quoted at about 36s. 6d. per ton, owing to increased activity at local light foundries. The market is steady in the Midlands, machinery metal being at 47s. 6d. and good pipe and plate scrap at 42s. 6d. A feature of the market in South Wales is that light cast iron is more active, at 38s. to 39s. per ton. In Scotland machinery scrap is quiet at 48s. 6d. to 49s., ordinary cast iron being at about 45s., for material in pieces not exceeding 1 cwt.

Metals.

Copper.—The immediate copper outlook is difficult to forecast, owing to the multiplicity of factors affecting the market. The wildly-fluctuating exchanges have been reflected in commodity quotations, the copper market being particularly affected by dollar movements. Owing to the uncertain currency relations, the domestic price of copper in the United States market (which is protected by a prohibitive tariff) has been below the European level. It has been difficult to judge the extent of the demand from consumers, as copper has been largely bought for purposes of business "cover" and of speculation.

Messrs. Henry Gardner's report states that: "Further depreciation of the exchange value of the dollar has brought about a higher cent price for electro. Not much outside business has taken place, as the extremely erratic exchange conditions, combined with the complete uncertainty as to the outlook, has caused consumers and dealers alike to hold aloof."

The week's prices have been as follow:—

Cash.—Thursday, £37 to £37 2s. 6d.; Friday, £36 13s. 9d. to £36 15s.; Monday, £37 17s. 6d. to £38; Tuesday, £38 5s. to £38 7s. 6d.; Wednesday, £38 18s. 9d. to £39.

Three Months.—Thursday, £37 3s. 9d. to £37 5s.; Friday, £36 16s. 3d. to £36 17s. 6d.; Monday, £38 to £38 2s. 6d.; Tuesday, £38 7s. 6d. to £38 10s.; Wednesday, £39 1s. 3d. to £39 2s. 6d.

Tin.—There is a considerable amount of uncertainty in the market as regards the probable course of tin prices this month. On the one hand, consumption is stated to be definitely improving, both in Europe and America, and world stocks of tin showed a further reduction, of about 2,200 tons, during June. On the other hand, the shadow of the Pool stocks still hangs over the market. It is reported that the disposal of these stocks, which amount to 21,000 tons, is to be begun this month; nothing is known as to the actual time or method of release. In view of the misgivings which this position has aroused, some sort of statement by the Pool would be welcomed, in the interests of a steady market. The situation is further complicated by the shortage of warrants on the London Exchange. It is interesting to note that English tin has enjoyed a sudden rise to favour amongst consumers, whilst the demand for Straits metal has fallen off, owing to the large premium (in the region of £20 per ton) recently asked for the latter. Considerable shipments of English tin have recently been made to New York. The premium on Straits tin has now been much reduced.

It is stated that an association is to be formed by the governors of the principal tin-producing countries to promote the marketing and consumption of the metal, on the lines of the new Copper Development Association.

Daily quotations:—

Cash.—Thursday, £222 15s. to £223; Friday, £221 10s. to £222; Monday, £223 5s. to £223 10s.; Tuesday, £223 15s. to £224; Wednesday, £225 7s. 6d. to £225 10s.

Three Months.—Thursday, £222 to £222 5s.; Friday, £220 10s. to £221; Monday, £222 10s. to £222 15s.; Tuesday, £223 5s. to £223 7s. 6d.; Wednesday, £224 15s. to £225.

Spelter.—Consumption of this metal seems to be moving in a favourable direction. Although there is no improvement in the galvanising trade, there has been a better demand for brass and zinc engineering manufactures, and zinc rollers have been more actively engaged. Messrs. Brandeis, Goldschmidt & Company report that: "There has been an active business in spelter and the market is in a healthy condition. Although considerable tonnages have been purchased it is doubtful whether this has been on account of consumers, who appear now to be well covered. Fears of depreciation of certain Continental currencies have been responsible for purchases of commodities in general, and spelter—although it is at a fair premium compared with lead—offers an attractive investment."

Price fluctuations:—

Ordinary.—Thursday, £17 10s.; Friday, £17 15s.; Monday, £17 10s.; Tuesday, £17 10s.; Wednesday, £18.

Lead.—A large number of consumers having covered their needs during the last two or three weeks, business has slowed down—a tendency accentuated by the uncertainty of the general situation. Quotations, however, are fairly well maintained. The manufacturers are well occupied, owing to the activity in the building industry.

Daily market prices:—

Soft Foreign (Prompt).—Thursday, £13 7s. 6d.; Friday, £13 6s. 3d.; Monday, £13 7s. 6d.; Tuesday, £13 10s.; Wednesday, £13 13s. 9d.

Powell Duffryn Souvenir.—When the delegates of the Institute of British Foundrymen, during the annual Conference at Cardiff, visited the engineering works of the Powell Duffryn Steam Coal Company, Limited, each visitor was handed a souvenir in the form of a booklet dealing with the various qualities of coke produced by the company, giving analyses, views of the coking plants and sections of coke.

Life of Ingot Moulds.—In "Jernkontorets Annaler," T. BERGLUND and A. JOHANSSON describe investigations on the life of ingot moulds carried out at several Swedish steel plants. The results obtained were in some respects divergent, but certain general conclusions could be drawn. The graphite should be neither too coarse nor too fine. In moulds cast from cupola furnaces the most favourable silicon and manganese contents appear to be 1.3 to 1.6 per cent. and 0.7 to 1.0 per cent. respectively. In moulds for soft steel the phosphorus content may, if the analysis is otherwise good, be as high as 0.2 per cent. A sulphur content of 0.1 per cent. appears to be favourable. No difference could be found between moulds cast in green sand and in dry sand. Annealing does not lengthen the life of the moulds. Moulds from electric furnaces, with more or less scrap from old moulds in the charge, as well as such in which the carbon content had been lowered by means of addition of steel, were not as uniform as moulds cast from cupola furnaces. Some moulds made of Bessemer pig-iron had an exceptionally long life. The deterioration of the interior surface of the mould seems to be connected with the decomposition of cementite into iron and temper carbon, which causes expansion and cracking of the surface.

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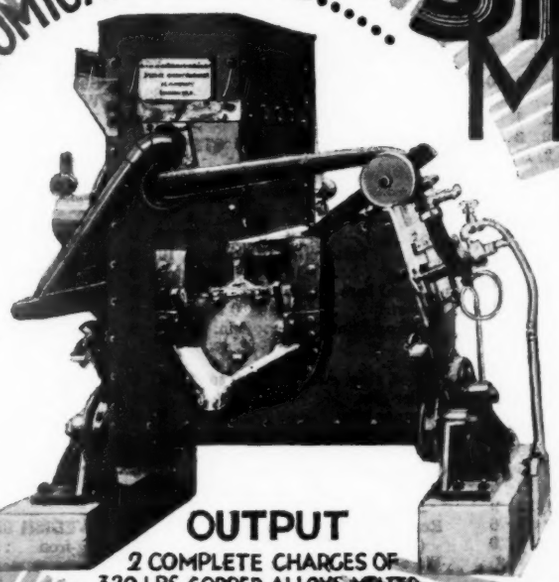
FOR FAST & ECONOMICAL MELTING.....

SKLENAR Midget FURNACE



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CHARACTERISTIC FEATURES:

No crucibles or pit fires required; Compact with rapidity of service; Perfect control of atmospheric conditions in the furnace with temperatures ranging from 500°C. to 1600°C.; Low fuel consumption; Better metal and reduced metallic losses; Metal under observation throughout; Reduced cost of upkeep; Cost of production reduced 60%; Perfect control of alloys; Oil burning equipment capable of running for long periods without fear of breakdown.

OIL CONSUMPTION: 4½ gallons per hour of fuel oil.
OTHER STANDARD SIZES FOR NON-FERROUS METALS: Coke or Oil fired up to 2 tons. Larger sizes on application.
OIL FIRED FURNACES FOR MELTING GREY IRON AND SEMI-STEEL: Sizes and prices on application.

WILL SAVE UP TO £900 PER ANNUM.

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XUM

RAW MATERIALS—PRICE LIST.

(Wednesday, July 5, 1933.)

COPPER.

	£	s.	d.
Standard cash	38	18	9
Three months	39	1	3
Electrolytic	42	10	0
Tough	40	15	0
Best selected	41	5	0
Sheets	68	0	0
India	50	10	0
Wire bars	41	10	0
Ingot bars	41	10	0
H.C. wire rods	43	10	0
Off. av. cash, June	36	16	1 3/16
Do., 3 mths., June	37	0	0 5/8
Do., Sttlmnt., June	36	16	3 3/8
Do., Electro, June	41	8	9 5/8
Do., B.S., June	40	3	0 3/8
Do., wire bars, June	41	17	7 3/8
Solid drawn tubes			10½d.
Brazed tubes			10½d.
Wire			7d.

BRASS.

Solid drawn tubes	9½d.
Brazed tubes	11½d.
Rods, drawn	8¾d.
Rods, extd. or rlld.	5d.
Sheets to 10 w.g.	8d.
Wire	7¾d.
Rolled metal	7½d.
Yellow metal rods	4¾d.
Do. 4 × 4 Squares	5¾d.
Do. 4 × 3 Sheets	5¼d.

TIN.

	£	s.	d.
Standard cash	225	7	6
Three months	224	15	0
English	226	15	0
Bars	228	5	0
Straits	234	0	0
Australian (nom.)	—		
Eastern	231	10	0
Banca (nom.)	233	0	0
Off. av. cash, June	220	1	8
Do., 3 mths., June	219	15	7 9/16
Do., Sttlmt., June	220	2	1 1/16

SPELTER.

	£	s.	d.
Ordinary	18	0	0
Remelted	17	15	0
Hard	15	0	0
Electro 99.9	20	10	0
English	18	17	6
India	16	10	0
Zinc dust	20	0	0
Zinc ashes	2	17	6
Off. aver., June	16	17	7 3/8
Aver. spot, June	16	19	9 1/16

LEAD.

	£	s.	d.
Soft foreign ppt.	13	13	9
Empire	13	15	0
English	15	0	0
Off. average, June	13	8	6½
Average spot, June	13	5	7½

ALUMINIUM.

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	25	5	0
Do., V.M. ex-whse.	25	0	0
Rods	30	0	0

ANTIMONY.

	£	s.	d.	£	s.	d.
English	37	10	0 to	40	0	0
Chinese				27	10	0
Crude				—		

QUICKSILVER.

	£	s.	d.	£	s.	d.
Quicksilver	8	15	0 to	9	5	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d.
Ferro silicon—			
25%	6	10	0
45/50%	12	10	0
75%	18	2	6
Ferro-vanadium—			
35/50%	12/8 lb. Va.		
Ferro-molybdenum—			
70/75% carbon-free of Mo.	6/3 per lb.		
Ferro-titanium—			
23/25% carbon-free	9d. lb.		
Ferro-phosphorus, 20/25%	£15	0	0
Ferro-tungsten—			
80/85%	1/6 lb.		
Tungsten metal powder—			
98/99%	1/9 lb.		
Ferro-chrome—			
2/4% car.	25	10	0
4/6% car.	21	17	6
6/8% car.	19	17	6
8/10% car.	18	17	6
Ferro-chrome—			
Max. 2% car.	30	0	0
Max. 1% car.	31	0	0
Max. 0.70% car.	42	10	0
70% carbon-free	10¾d.		
Nickel—99.5/100%	£225 to £230		
"F" nickel shot	£202	10	0
Ferro-cobalt	5/9 lb.		
Aluminium 98/99%	£100	0	0
Metallic chromium—			
96/98%	2/8 lb.		
Ferro-manganese (net)—			
76/80% loose	£10 15 0 to £11	5	0
76/80% packed	£11 15 0 to £12	5	0
76/80% export (nom.)	£9	15	0
Metallic manganese—			
94/96% carbon-free	1/2 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/32 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ¾ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel	2	4	0 to	2	5	0
Bundled steel and shrngs.	1	17	6 to	2	4	0
Mixed iron and steel	2	0	0 to	2	1	6
Heavy cast iron	2	2	6 to	2	3	6
Good machinery	2	8	0 to	2	10	0
Cleveland—						
Heavy steel				2	2	6
Steel turnings				1	10	0
Cast-iron borings				1	3	0
Heavy forge				2	10	0
W.I. piling scrap				2	0	0
Cast-iron scrap	1	19	0 to	2	1	0
Midlands—						
Light cast-iron scrap				1	17	6
Heavy wrought iron				2	5	0
Steel turnings, f.o.r.				1	5	6
Scotland—						
Heavy steel				1	18	9
Ordinary cast iron				2	5	0
Engineers' turnings				1	12	0
Cast-iron borings	1	12	6 to	1	13	9
Wrought-iron piling	2	1	3 to	2	2	6
Heavy machinery	2	8	6 to	2	9	0

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	30	0	0
Brass	19	0	0
Lead (less usual draft)	12	0	0
Tea lead	10	0	0
Zinc	11	0	0
New aluminium cuttings	74	0	0
Braziery copper	26	0	0
Gunmetal	24	0	0
Hollow pewter	140	0	0
Shaped black pewter	100	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	65/-
Foundry No. 3	62/6
,, at Falkirk	62/3
,, at Glasgow	65/3
Foundry No. 4	61/6
Forge No. 4	61/6
Hematite No. 1, f.o.t.	59/6
Hematite M/Nos., f.o.t.	59/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	68/6
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	62/-
,, No. 3 fdry.	66/-
Northants forge	58/6
,, fdry. No. 3	62/6
,, fdry. No. 1	65/6
Derbyshire forge	62/-
,, fdry. No. 3	66/-
,, fdry. No. 1	69/-
Scotland—	
Foundry No. 1	67/6
,, No. 3	65/-
Hem. M/Nos. d/d	66/-
Sheffield (d/d district)—	
Derby forge	59/6
,, fdry. No. 3	63/6
Lincs forge	59/6
,, fdry. No. 3	63/6
E.C. hematite	73/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	82/-
Clyde, No. 3	82/-
Monkland, No. 3	82/-
Summerlee, No. 3	82/-
Eglinton, No. 3	82/-
Gartsherrie, No. 3	82/-
Shotts, No. 3	82/-

FINISHED IRON AND STEEL.

Usual district deliveries for iron; delivered consumer's station for steel.

	£	s.	d.	£	s.	d.
Iron—						
Bars (cr.)	9	0	0 to	9	15	0
Nut and bolt iron	6	15	0 to	7	10	0
Hoops	10	10	0 to	12	0	0
Marked bars (Staffs) f.o.t.				12	0	0
Gas strip	10	10	0 to	12	0	0
Bolts and nuts, ¾ in. × 4 in.				13	0	0
Steel—						
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.				8	5	0
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ⅜ in. (Untested)	6	17	6 & up.			
Flats—8 in. wide and over				8	12	6
,, under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0 to	8	10	0
Fishplates				12	0	0
Hoops (Staffs)	9	10	0 & up.			
Black sheets, 24g. (10-t. lots)				10	0	0
Galv. cor. shts. ,,				12	10	0
Galv. flat shts. ,,				13	0	0
Galv. fencing wire, 8g. plain				14	0	0
Billets, soft	5	0	0 to	5	12	6
Billets, hard	6	12	6 to	7	2	6
Sheet bars	4	15	0 to	5	2	6
Tin bars				4	15	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	11d.
Sheet to 10 w.g.	12d.
Wire	12½d.
Rods	11d.
Tubes	15½d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	16.34
No. 2 foundry, Valley	15.50
No. 2 foundry, Birm.	12.00
Basic	16.89
Bessemer	17.89
Malleable	17.39
Grey forge	17.39
Ferro-mang. 80%, seaboard	68.00
O.-h. rails, h'y, at mill	40.00
Billets	26.00
Sheet bars	26.00
Wire rods	35.00
	Cents.
Iron bars, Phila.	1.86
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Steel hoops	1.55
Sheets, black, No. 24	2.10
Sheets, galv., No. 24	2.70
Wire nails	1.85
Plain wire	2.10
Barbed wire, galv.	2.35
Tinplates, 100-lb. box	$4.25

COKE (at ovens).

Welsh foundry	20/- to 22/6
,, furnace	15/- to 16/-
Durham and Northumberland—	
,, foundry	21/- to 25/-
,, furnace	13/3
Midlands, foundry	—
,, furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box		17/3 to 17/6
,,	28×20	,,	34/6 to 35/-
,,	20×10	,,	24/9 to 25/3
,,	18¾×14	,,	18/- to 18/3
C.W.	20×14	,,	16/- to 16/6
,,	28×20	,,	33/3 to 33/6
,,	20×10	,,	22/9
,,	18¾×14	,,	16/6

SWEDISH CHARCOAL IRON & STEEL.

	£	s.	d.	£	s.	d.
Pig-iron	£6	0	0 to	£7	0	0
Bars-hammered, basis	£16	0	0 to	£16	10	0
Bars and nail-rods, rolled, basis	£15	15	0 to	£16	0	0
Blooms	£10	0	0 to	£12	0	0
Keg steel	£30	0	0 to	£31	0	0
Faggot steel	£18	0	0 to	£23	0	0
Bars and rods dead soft, st'l	£10	0	0 to	£12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
June	29 ..	37	0	0	dec.	12/6
,,	30 ..	36	13	9	,,	6/3
July	3 ..	37	17	6	inc.	23/9
,,	4 ..	38	5	0	,,	7/6
,,	5 ..	38	18	9	,,	13/9

Electrolytic Copper.

		£	s.	d.		
June	29 ..	40	10	0	dec.	15/-
,,	30 ..	40	10	0	No change	
July	3 ..	41	0	0	inc.	10/-
,,	4 ..	42	0	0	,,	20/-
,,	5 ..	42	10	0	,,	10/-

Standard Tin (cash).

		£	s.	d.		
June	29 ..	222	15	0	dec.	50/-
,,	30 ..	221	10	0	,,	25/-
July	3 ..	223	5	0	inc.	35/-
,,	4 ..	223	15	0	,,	10/-
,,	5 ..	225	7	6	,,	32/6

Tin (English ingots).

		£	s.	d.		
June	29 ..	224	5	0	dec.	45/-
,,	30 ..	223	5	0	,,	20/-
July	3 ..	224	15	0	inc.	30/-
,,	4 ..	225	5	0	,,	10/-
,,	5 ..	226	15	0	,,	30/-

Spelter (ordinary).

		£	s.	d.		
June	29 ..	17	10	0	dec.	8/9
,,	30 ..	17	15	0	inc.	5/-
July	3 ..	17	10	0	dec.	5/-
,,	4 ..	17	10	0	No change	
,,	5 ..	18	0	0	inc.	10/-

Spelter (Electro, 99.9 per cent.).

		£	s.	d.		
June	29 ..	19	17	6	dec.	7/6
,,	30 ..	20	0	0	inc.	2/6
July	3 ..	20	0	0	No change	
,,	4 ..	20	0	0	,,	,,
,,	5 ..	20	10	0	inc.	10/-

Zinc Sheets (English).

		£	s.	d.		
June	29 ..	25	5	0	No change	
,,	30 ..	25	5	0	,,	,,
July	3 ..	25	5	0	,,	,,
,,	4 ..	25	5	0	,,	,,
,,	5 ..	25	5	0	,,	,,

Lead (English).

		£	s.	d.		
June	29 ..	14	15	0	No change	
,,	30 ..	14	15	0	,,	,,
July	3 ..	14	15	0	,,	,,
,,	4 ..	15	0	0	inc.	5/-
,,	5 ..	15	0	0	No change	

AVERAGE MONTHLY PRICES OF STEEL SHIP PLATES (NORTH OF ENGLAND).

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1897	5 10 0	5 10 0	5 10 0	5 7 6	5 2 6	5 2 6	5 0 0	5 0 0	5 0 0	5 0 0	5 7 6	5 10 0	5 5 5
1898	5 10 0	5 8 9	5 8 9	5 10 0	5 16 3	5 18 9	5 17 6	6 0 0	6 2 6	6 5 0	6 10 0	6 15 0	5 18 6½
1899	6 15 0	7 0 0	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 12 6	7 12 6	7 12 6	7 12 6	8 0 0	7 6 5½
1900	8 0 0	8 0 0	8 2 6	8 5 0	8 7 6	8 7 6	8 7 6	8 0 0	8 0 0	8 0 0	7 10 0	7 0 0	8 0 0
1901	6 15 0	6 15 0	6 5 0	6 0 0	6 0 0	6 0 0	6 0 0	6 5 0	6 7 6	6 5 0	6 0 0	6 0 0	6 4 4
1902	5 17 6	5 12 6	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 10 0	5 14 7½
1903	5 10 0	5 10 0	5 15 0	6 0 0	6 0 0	6 0 0	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 10 0	5 13 11
1904	5 7 6	5 10 0	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 11 10
1905	5 15 0	5 17 6	5 17 6	5 17 6	5 17 6	5 17 6	5 17 6	5 17 6	6 0 0	6 10 0	7 0 0	7 0 0	6 2 3½
1906	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 10 0	7 0 10½
1907	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 0 0	7 0 0	7 8 4
1908	6 10 0	6 10 0	6 10 0	6 5 0	6 5 0	6 5 0	6 0 0	6 0 6	6 0 0	6 0 0	6 0 0	6 0 0	6 3 9
1909	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	5 15 0	5 15 0	5 15 0	6 0 0	6 0 0	6 0 0	6 0 0	5 18 9
1910	6 5 0	6 5 0	6 7 6	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 2
1911	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 18 4	6 15 3½
1912	7 3 9	7 5 0	7 5 0	7 12 6	7 15 0	7 15 0	7 15 0	8 0 0	8 0 0	8 0 0	8 2 0	8 5 0	7 14 10
1913	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	7 19 0	7 15 0	7 3 0	6 15 0	6 10 0	7 10 5½
1914	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 0 0	6 0 0	7 0 0	7 5 0	7 5 0	7 6 3	7 10 0	6 14 8½
1915	8 0 0	8 10 0	9 0 0	9 10 0	9 10 0	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	10 5 0	11 0 0	9 12 11
1916	11 7 6	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 9 2
1917	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0
1918	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0
1919	11 10 0	14 0 0	14 0 0	14 0 0	17 0 0	17 7 6	17 15 0	18 5 0	18 5 0	18 5 0	19 12 6	21 5 0	16 15 5
1920	22 10 0	23 10 0	23 10 0	23 10 0	23 10 0	23 10 0	23 10 0	23 10 0	24 0 0	24 10 0	24 5 0	24 5 0	23 13 4
1921	23 5 0	22 10 0	20 4 0	19 0 0	19 0 0	17 0 0	15 0 0	14 15 0	13 12 0	12 5 0	10 10 0	10 10 0	16 9 3
1922	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 4 0	10 0 0	9 7 6	9 4 0	9 5 0	9 5 0	9 5 0	9 18 4½
1923	9 7 6	9 15 0	10 5 0	10 10 0	10 10 0	10 10 0	9 18 9	9 17 6	9 17 6	9 17 6	9 18 6	10 6 10½	10 1 2½
1924	10 1 6	9 18 1½	9 17 6	9 17 6	9 17 6	9 19 4½	10 5 0	10 5 0	10 5 0	9 19 0	9 15 0	9 15 0	9 19 7½
1925	9 14 0	9 10 0	9 10 0	9 1 3	9 0 0	9 0 0	8 17 0	8 13 1½	8 7 6	8 5 6	7 16 3	7 14 3	8 15 8½
1926	7 12 2½	7 12 6	7 12 6	7 14 4½	7 15 0	7 16 10½	8 2 6	8 2 6	8 4 0	8 12 6	8 12 6	8 16 3	8 1 1½
1927	8 17 6	8 17 6	8 11 6	8 7 6	8 6 3	8 5 0	8 5 0	8 3 9	8 2 6	8 2 6	8 5 0	8 5 0	8 7 5
1928	8 2 6	8 5 0	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 6 10½
1929	8 7 6	8 7 6	8 7 6	8 7 6	8 10 6	8 12 6	8 12 6	8 12 6	8 12 6	8 12 6	8 12 6	8 13 9	8 10 9½
1930	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1931	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1932	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1933	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	—	—	—	—	—	—	—

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

PATTERNSHOP.—Assistant Foreman required by prominent Midland gas-appliance manufacturers: accustomed to modern methods of patternmaking for mass production of stove castings, including those required for mechanised units.—Give details of experience, age and salary required, to Box 458, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Foreman, with thorough knowledge production high-class light and medium grey-iron castings, wanted, able get maximum possible output. Progressive position. Preference given to one able to take shares. Foundry capacity 40 tons weekly.—Box 450, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

FOUNDRY Manager is open for re-engagement. Experience includes management of foundries producing highest-class castings on repetition basis, automobile, etc. Accustomed to getting best results from all types of machines and mechanised plant. (216)

FOREMAN requires similar position or as Assistant Foreman. Engineering, machine tool and millwright castings, cupola practice, high-duty cast iron; accustomed to systems of payment by result. (217)

FOUNDRY Foreman or Assistant Foreman: position required by practical man with sound experience on general engineering, ferrous and non-ferrous, machine-moulding, and special knowledge of pipe-founding. Good technical knowledge. (218)

YOUNG Metallurgical Chemist, four years' laboratory and practical steel-foundry experience, desires position. Has been engaged on steel-foundry, iron-foundry, general metallurgical and laboratory work. (219)

BUSINESS FOR SALE.

RE GEORGE CAWWOOD & SON, LIMITED, WESTGATE FOUNDRY, ROTHERHAM

(In Voluntary Liquidation).

THE Liquidator of the above Company is prepared to consider offers for Purchase as a Going Concern of the old-established business of Ironfounders carried on by the above company.

The business, which is a very old-established one specialising in Railway-Wagon Castings, is situate close to the Westgate Railway Station, Rotherham.

Offers are now invited for the Purchase of the Freehold Land and Buildings, Goodwill, Machinery and Plant, Loose Tools and Patterns in One Lot as a Going Concern.

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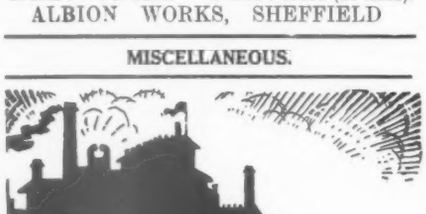

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